Bacteria-Impaired Waters TMDL Project I for Beaches and Creeks in the San Diego Region

TECHNICAL DRAFT

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1 Executive Summary

Section 303(d) of the Clean Water Act (CWA) requires that each State identify waterbodies within its boundaries for which the effluent limitations are not stringent enough to meet applicable water quality standards (i.e., water quality objectives and beneficial uses). The CWA also requires states to establish a priority ranking for these impaired waters, known as the Section 303(d) list, and to establish Total Maximum Daily Loads (TMDLs) for such waters. The purpose of a TMDL is to restore the beneficial uses and to attain the water quality objectives in the waterbody. A TMDL represents the maximum amount of the pollutant of concern that the waterbody can receive and still attain water quality standards. Once this maximum pollutant amount has been calculated, it is then divided up and allocated amongst all of the contributing sources in the watershed. In order to meet the TMDL, an Implementation Plan is also developed that describes the pollutant reduction actions that must be taken by various responsible parties to meet the allocations. The Implementation Plan includes a time schedule for meeting the required pollutant reductions and requirements for monitoring to assess the effectiveness of the load reduction activities in attaining water quality objectives and restoring beneficial uses.

The California Regional Water Quality Control Board, San Diego Region (Regional Board) is responsible under the California Water Code for protecting the beneficial uses of the waters of the State in the San Diego Region by regulating the discharge of pollutants to those waters, as required under the CWA. Due to frequent, high concentrations of bacteria, the Regional Board placed 38 waterbodies, comprising approximately 50 miles of coastal shoreline and creeks, and 2000 acres of bays and lagoons, on the 2002 CWA Section 303(d) list as impaired, i.e., not meeting applicable water quality standards. Bacteria densities have been found to frequently exceed the numeric water quality objectives (WQOs) for total, fecal, and enterococcus bacteria as defined in the Regional Board's Water Quality Control Plan for the San Diego Basin (Basin Plan). These exceedances threaten or impair the water contact, non-water contact, and shellfish harvesting beneficial uses of the listed waterbodies.

United State Environmental Protection Agency (USEPA) used CWA Section 106 funds to contract the environmental consulting firm, Tetra Tech, to provide technical assistance to the Regional Board in calculating the TMDLs for the impaired waterbodies through the development of Region-wide watershed models. This project, known as the *Bacteria-Impaired Waters TMDL Project I for Beaches and Creeks* (Bacteria Project I), was developed to address 18 out of the 38 bacteria-impaired waterbodies on the 2002 CWA Section 303(d) list in the San Diego Region. This project includes TMDL calculations for roughly 24 miles of coastal shoreline and creeks. The remaining 20 bacteria-impaired waters will be addressed in an upcoming subsequent TMDL project known as *Bacteria Impaired Waters TMDL Project II for Bays and Lagoons* (Bacteria Project II). This project is in its very preliminary stages and will result in TMDL calculations for roughly 2000 acres of impaired bays and lagoons and 26 miles of impaired coastal shoreline adjacent to lagoons.

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Total Maximum Daily Loads (TMDLs) were developed to meet water quality objectives and protect beneficial uses in the bacteria-impaired waterbodies included in this project (Appendix A).

The final numeric targets for the TMDLs were set equal to the numeric water quality objectives associated with the water contact (REC1) beneficial use for fecal coliform and enterococcus bacteria as defined in the Regional Board's Basin Plan. For total coliform, the final numeric targets were set equal to the numeric water quality objectives associated with the shellfish harvesting (SHELL) beneficial use. In addition, during wet weather, an interim numeric target was established based on a "reference approach" that allows a certain number of exceedance frequencies of the water quality objectives during wet-weather conditions to account for natural sources of bacteria in a watershed (e.g., bird or wildlife waste). In areas where background sources of bacteria can, by themselves, result in non-attainment of Basin Plan WQOs, it is often useful to compare the watershed to a reference watershed representative of natural conditions. The reference approach ensures that water quality objectives are at least as good as conditions observed at a reference watershed, while accounting for the impact of natural sources on water quality. Furthermore, the approach ensures no further bacteriological degradation of water quality where existing conditions are better than the reference watershed. This approach was used by the Los Angeles Regional Water Quality Control Board (LA Regional Board) for developing bacteria TMDLs for Malibu Creek and the Santa Monica Bay beaches (LARWQCB, 2002, and 2003).

Sources of bacteria were identified in the source analysis to originate from urban runoff, natural background, homeless encampments, and sewage spills from wastewater treatment plants. It was determined that by far, the most significant controllable source of bacteria to receiving waters is urban runoff discharges from Municipal Separate Storm Sewer Systems (MS4s) during both wet and dry weather. In wet weather, it was found that the amount of runoff and associated bacteria concentrations are highly dependent on land use and associated management practices (e.g., management of livestock in agricultural areas, pet waste in residential areas). In dry weather, the amount of runoff and associated bacteria concentrations come from various land use practices that cause water to enter storm drains and creeks, such as lawn irrigation runoff and car washing. The natural sources were largely determined to be uncontrollable and have been accounted for through the use of the reference approach discussed above.

To determine existing bacteria loads and assign TMDLs to these impaired waterbodies, a regional watershed-based approach (model study) was developed. For wet weather modeling analysis, a modeling system was used to simulate the build-up and wash-off of bacteria, and the hydrologic and hydraulic processes that affect delivery to the impaired waters. The wet-weather approach was based on the application of the United States Environmental Protection Agency's (USEPA) Loading Simulation Program in C++ (LSPC) to estimate bacteria loading from streams and assimilation within the waterbody.

For dry weather, a different approach was necessary due to the variable nature of bacteria concentrations in the receiving waters. In order to represent the linkage between source contributions and in-stream response, a steady-state mass balance model was developed to simulate transport of bacteria in the impaired streams and the streams flowing to impaired shorelines. The model was created to estimate bacteria concentrations in the San Diego Region, to develop necessary load allocations for TMDL development, and to allow for readily incorporating any new data. Bacteria concentrations in each segment were calculated using water quality data, a first-order die-off rate, stream infiltration, basic channel geometry, and flow.

The TMDLs and waste load allocations were calculated for each impaired waterbody included in this report, for both wet and dry weather. These results are presented in Table 7-1. The Implementation Plan for this TMDL will be developed by the Regional Board at a future date.

2 Introduction

Section 303(d) of the Clean Water Act (CWA) requires states to conduct biennial assessments of waters not meeting water quality standards and to develop lists of impaired waters. States are further required to establish a priority ranking for waters on the Section 303(d) list and to establish Total Maximum Daily Loads (TMDLs) for these waterbodies. A TMDL establishes the allowable load of a pollutant based on the relationship between pollutant sources and attainment of water quality standards. It provides the scientific basis to establish water quality-based controls to reduce pollution from point and nonpoint sources in order to attain water quality objectives and restore and protect the beneficial uses of the impaired waterbody.

The TMDL process begins with the development of a technical report which includes the following 7 components: (1) a **Problem Statement** describing which water quality objectives are not being attained and which beneficial uses are impaired; (2) identification of **Numeric Targets** which will result in attainment of the water quality objectives and protection of beneficial uses; (3) a **Source Analysis** to identify all of the point and nonpoint sources of the impairing pollutant in the watershed and to estimate the current pollutant loading for each source; (4) a **Linkage Analysis** to calculate the **Loading Capacity** of the waterbody for the pollutant; i.e., the maximum amount of the pollutant that may be discharged to the waterbody without causing exceedances of water quality objectives and impairment of beneficial uses; (5) a **Margin of Safety** (MOS) to account for uncertainties in the analysis; (6) the division and **Allocation** of the TMDL among each of the contributing sources in the watershed, waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint and background sources; (7) a description of how **Seasonal Variation and Critical Conditions** are accounted for in the TMDL determination. The document containing the above components is generally referred to as the technical TMDL report.

The Regional Board will develop the **Implementation Plan** for this TMDL at a future date. The Implementation Plan will describe the pollutant reduction actions that must be taken by various responsible parties to meet the allocations. A time schedule for meeting the required pollutant reductions will be included in the Implementation Plan. In addition, the Implementation Plan will include requirements for monitoring that must be implemented to assess the effectiveness of the load reduction activities in attaining water quality objectives and restoring beneficial uses. Public participation is a key element of the TMDL process, and stakeholder involvement is encouraged and required.

3 Problem Statement

The *Bacteria-Impaired Waters TMDL Project I for Beaches and Creeks* (Bacteria Project I) was developed to address 18 out of the 38 bacteria-impaired waterbodies on the 2002 CWA Section 303(d) list in the San Diego Region. In order to address these impairments, the San Diego Regional Water Quality Control Board (Regional Board) and the United States Environmental Protection Agency (USEPA) coordinated a watershed assessment and modeling study to support the development of TMDLs. In order to assist the Regional Board in the development of the technical portion of the Bacteria Project I TMDLs, USEPA used CWA Section 106 funds to contract the environmental consulting firm, Tetra Tech. Tetra Tech has provided the Regional Board with technical assistance in calculating the TMDLs for the impaired waterbodies through the development of Region-wide watershed models.

The Bacteria Project I resulted in the development of TMDLs for 45 impaired beach segments and 6 creeks of the San Diego Region, amounting to roughly 24 miles of coastal shoreline and inland surface waters, or creeks (Appendix A). Bacteria densities in these waterbodies have chronically exceeded the numeric water quality objectives for total, fecal, and/or enterococci bacteria. These exceedances threaten and impair the water contact (REC-1), non-water contact (REC-2), and shellfish harvesting (SHELL) beneficial uses. To determine existing bacteria loads and assign TMDLs to these multiple impaired waterbodies, a regional watershed-based approach was developed. This approach is consistent with the methodologies used for bacteria TMDL development for impaired coastal areas of the Los Angeles Region, specifically the Santa Monica Bay beaches (LARWQCB, 2002) and Malibu Creek (LARWQCB, 2003).

In preparing the TMDLs, a distinction was made between wet and dry weather because the method of delivery of bacteria to the receiving waterbodies vary between the two conditions. During wet weather the sources of bacteria are usually associated with wash-off of loads accumulated on the land surface. During rain events these bacteria loads are delivered to the waterbody via creeks and stormwater collection systems. In dry weather bacteria loads are transported to surface waters through other events, such as runoff from lawn irrigation or pavement cleaning. Other possible sources of bacteria during wet and dry weather include birds nesting in coastal marshes and lagoons, sewer line breaks, illegal sewage disposal from boats along the coastline, and encampments of homeless persons (note that lagoons and adjacent shoreline areas are not addressed in the TMDLs reported herein).

3.1 Project Area Description

The impaired waters addressed in this analysis are in southern California, primarily in Orange and San Diego Counties. The beaches, creeks, and lagoons are threatened and impaired because of elevated bacteria levels are located within or hydraulically downstream five watersheds in Orange County (with a small portion in Riverside

County) (Figure 1-1) and eight watersheds in San Diego County (Figure 1-2). Table 1-1 lists the watersheds that affect the bacteria-impaired waterbodies in the region. Most of the waterways flow directly to the Pacific Ocean, except Chollas Creek and the upper portion of Pine Creek, which flow to San Diego Bay and Cottonwood Creek, respectively. The combined watersheds cover 1,758 square miles (4,553 square kilometers).

The climate in the region is generally mild with annual temperatures averaging around 65°F near the coastal regions. Annual average rainfall ranges from 9 to 11 inches along the coast to more than 30 inches in the eastern mountains. There are two distinct climatic periods: a dry period from late April to mid-October and a wet period from mid-October through late April. The wet period provides 85 to 90 percent of the annual rainfall (County of San Diego, 2000).

The land use of the region is highly variable. The coastline areas are highly concentrated with urban and residential land uses, and the inland areas primarily consist of open space. Most of the contributing area is open space or recreational land use (64.2 percent), followed by low-density residential (14.1 percent) and agriculture/livestock (12.4 percent) land uses. Other major land uses are commercial/institutional (3.0 percent), high-density residential (2.2 percent), industrial/transportation (1.6 percent), military (1.0 percent), transitional (0.8 percent), and water (0.7 percent).

3.2 Impairment Overview

The Regional Board included the waterbodies addressed in this TMDL study on 2002 section 303(d) lists as impaired primarily because of non-attainment of the bacteria objectives associated with contact recreation. The beaches were listed as impaired because the total coliform (TC), fecal coliform (FC), and/or enterococcus (ENT) bacteria water quality objectives were exceeded based on shoreline monitoring data (data provided by the San Diego County Department of Environmental Health [DEH] and the Orange County Health Care Agency). For more information regarding the methodology for section 303(d) listing of beaches for bacteria during the 2002 list update, see Appendix K.

For this study, a regionalized watershed-based approach was developed to calculate bacteria loadings for the majority of the Regional Board's impaired shoreline and creek segments. Although seven coastal lagoons are also listed as impaired because of bacteria, the approach outlined in this document is not applicable for calculation of TMDLs for those waterbodies. Table 1-1 lists the impaired waterbodies addressed in this study. With the exception of Pine Valley Creek, most creeks addressed in the study are near the shoreline and impaired beach segments. The drainage areas of many of the watersheds that affect shoreline impairments are located above more than one impaired beach segment. Table 1-1 lists the watersheds (shown in Figures 1-1 and 1-2) that affect impaired waterbodies due to bacteria loadings. Appendix A provides a more detailed list of the waterbodies on the section 303(d) list, including waterbody segment names and impaired miles.

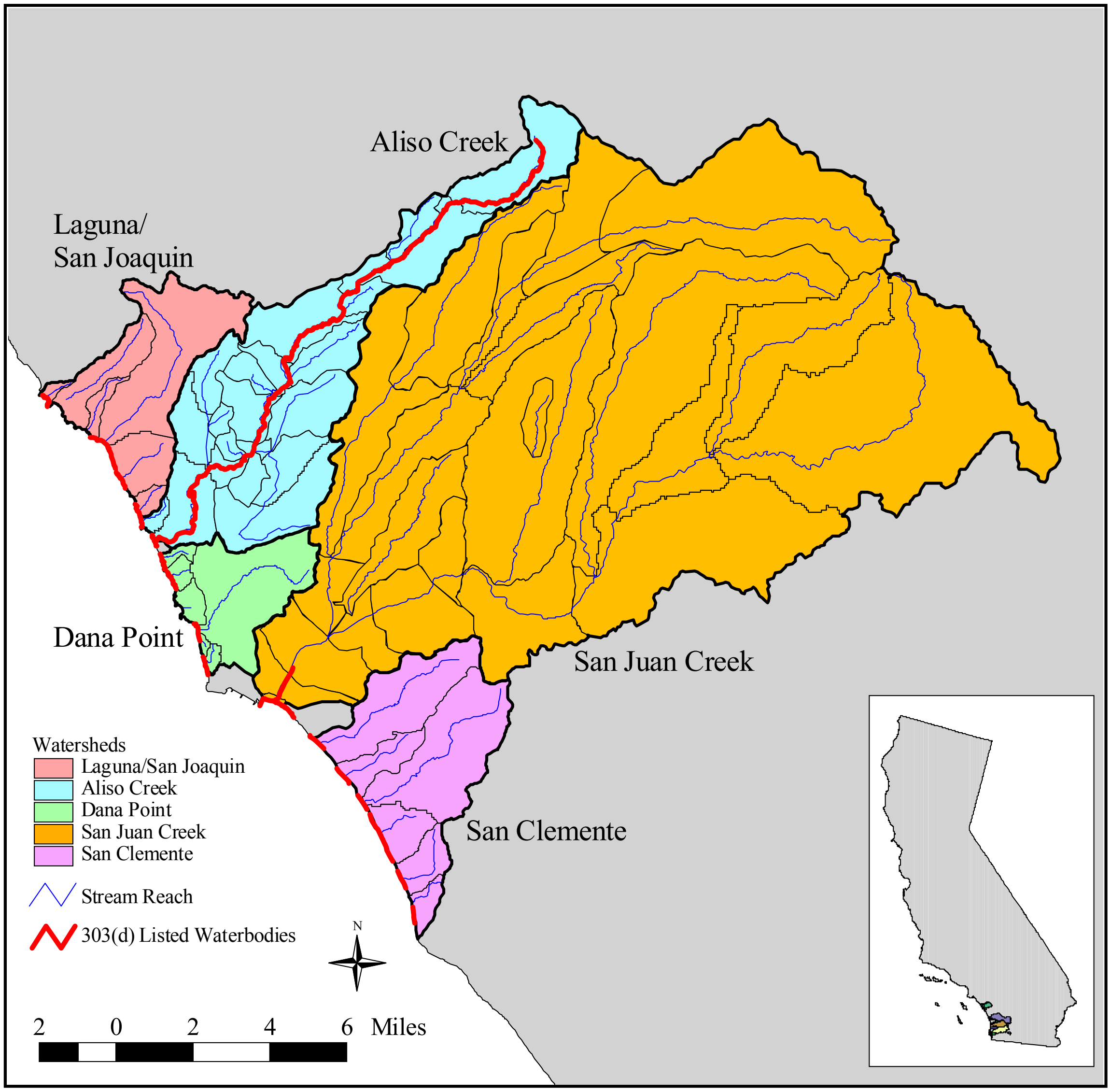

Figure 1-1. Watersheds of interest in Orange County.

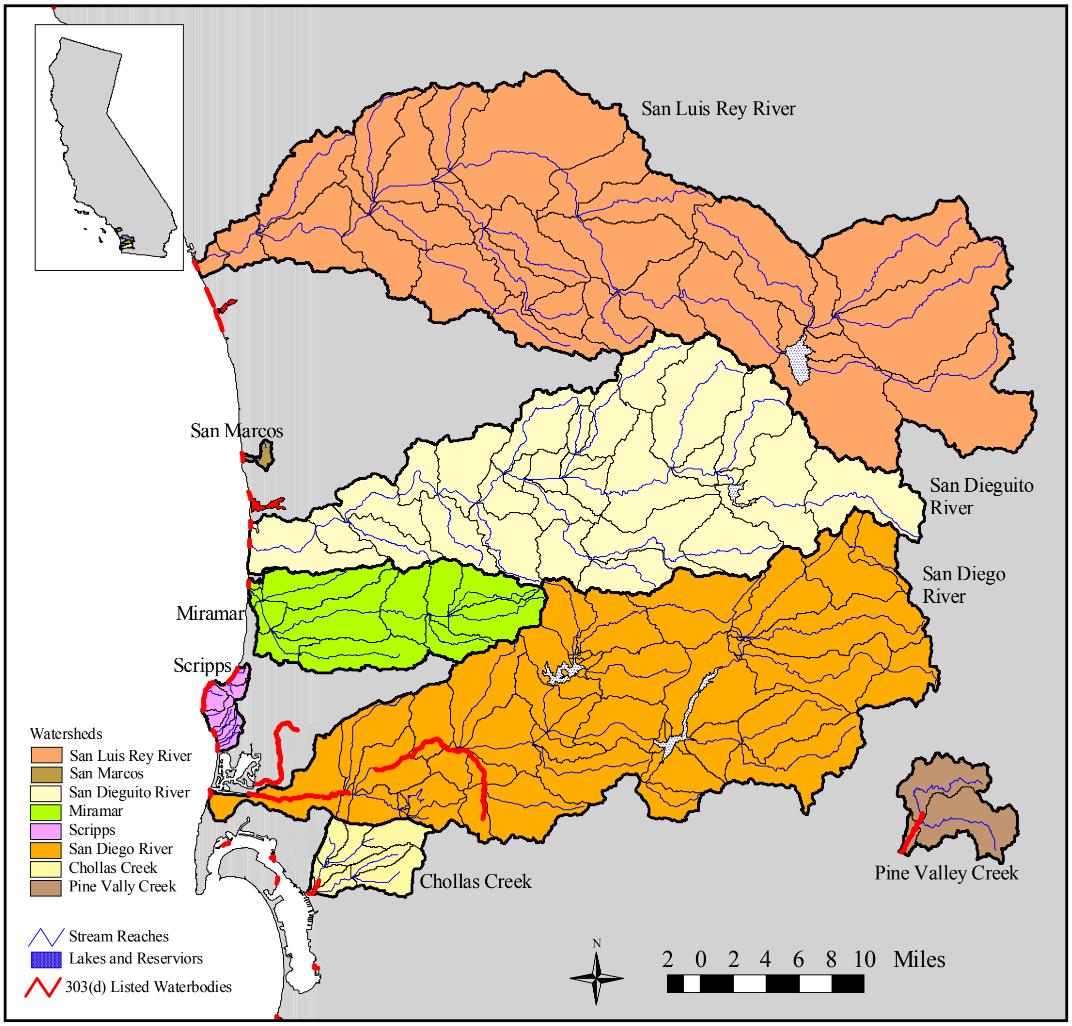

Figure 1-2. Watersheds of interest in San Diego County.

Table 1-1. Bacteria-Impaired Waters Addressed in This Analysis

Watershed	Type of 303(d) Listing	303(d) Listed Waterbody Name [a]	Drainage Area (mi^2)[b]
Laguna/San Joaquin	Shoreline	Pacific Ocean Shoreline, Laguna Beach HSA, San Joaquin Hills HSA	13.94
Aliso Creek	Creek, Shoreline	Aliso Creek, Aliso Creek (mouth), Pacific Ocean Shoreline, Aliso HSA	35.74
Dana Point	Shoreline	Pacific Ocean Shoreline, Dana Point HSA (Salt Creek)	8.89
San Juan Creek	Creek	Lower San Juan HSA	177.18
San Clemente	Shoreline	Pacific Ocean Shoreline, San Clemente HA	18.78
San Luis Rey River	Shoreline	Pacific Ocean Shoreline, San Luis Rey HU	560.42 (354.12)
San Marcos	Shoreline	Pacific Ocean Shoreline, San Marcos HA	1.43
San Dieguito River	Shoreline	Pacific Ocean Shoreline, San Diequito HU (Bell Valley)	346.22 (292.24)
Miramar	Shoreline	Pacific Ocean Shoreline, Miramar Reservoir HA	93.73
Scripps	Shoreline	Pacific Ocean Shoreline, Scripps HA	8.75
San Diego River	Creek, Shoreline	Forester Creek, San Diego River (Lower), Pacific Ocean Shoreline, San Diego HU	436.48 (173.95)
Chollas Creek	Creek	Chollas Creek	26.80
Pine Valley Creek	Creek	Pine Valley Creek (Upper)	29.53

Note: HSA = hydrologic subarea; HA = hydrologic area; HU = hydrologic unit
[a] Listed for FC, TC, and ENT, with the exception of Pine Valley Creek (Upper) which is listed only for ENT.
[b] The areas listed are for wet weather conditions. The areas listed in parenthesis are for dry weather conditions because watersheds above large reservoirs and lakes impound runoff during dry periods.

3.3 Applicable California Water Quality Standards

Water quality standards consist of water quality objectives and beneficial uses. Water quality objectives are defined under CWC Section 13050(h) as "limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water." Under Section 304(a)(1) of the CWA, the United States Environmental Protection Agency (USEPA) is required to publish water quality criteria that incorporate ecological and human health assessments based on current scientific information. Water quality objectives must be based on scientifically sound water quality criteria, and be at least as stringent as those criteria.

The *San Diego Regional Water Quality Control Plan* (Basin Plan) identifies beneficial uses and water quality objectives for each waterbody. Table 2-1 lists the beneficial uses for each of the impaired inland segments and the Pacific shoreline. The beneficial use designations are as follows:

- Municipal and domestic supply (MUN)
- Agricultural supply (AGR)
- Industrial process supply (PROC)
- Industrial water supply (IND)
- Ground water recharge (GWR)
- Freshwater replenishment (FRSH)
- Navigation (NAV)
- Hydropower generation (POW)
- Water contact recreation (REC-1)
- Non-contact recreation (REC-2)
- Commercial and sport fishing (COMM)
- Aquaculture (AQUA)
- Warm freshwater habitat (WARM)
- Cold freshwater habitat (COLD)
- Inland saline water habitat (SAL)
- Estuarine habitat (EST)
- Marine habitat (MAR)
- Wildlife habitat (WILD)
- Preservation and enhancement of "Areas of Special Biological Significance" (BIOL)
- Rare and endangered species (RARE)
- Migration of aquatic organisms (MIGR)
- Spawning, reproduction, and/or early development (SPWN)
- Shellfish harvesting (SHELL)

The Basin Plan contains bacteria WQOs to protect the REC-1, REC-2, and SHELL uses. For bacteria, the protection at SHELL objectives is protective of all other uses. The relevant WQOs for indicator bacteria are listed in Table 2-2. For a complete discussion of WQOs for each beneficial use, see Appendix J.

Although WQOs are written in terms of concentration of bacteria indicator colonies, non-attainment of beneficial uses is actually caused by the presence of disease-causing pathogens. At present, it is difficult to measure pathogens directly, and for this reason high concentrations of indicator bacteria are thought to indicate the presence of pathogens. For a complete discussion of the use of bacteria indicators to measure water quality and the presence of pathogens, see Appendix L.

Table 2-1. Beneficial Uses of the Impaired Streams

Waterbody Type	Waterbody	Designated Uses
Creek	Aliso Creek	MUN,[a] AGR, REC-1,[b] REC-2, WARM, WILD
Creek	San Juan Creek	MUN,[a] AGR, IND, REC-1, REC-2, WARM, COLD, WILD
Creek	Forrester Creek	MUN,[b] IND, REC-1, REC-2, WARM, WILD
Creek	San Diego River, Lower	MUN,[a] AGR, IND, REC-1, REC-2, WARM, WILD, RARE
Creek	San Diego River, Lower	MUN,[b] IND, REC-1, REC-2, WARM, WILD, RARE
Creek	Chollas Creek	MUN,[a] REC-1,[b] REC-2, WARM, WILD
Creek	Pine Valley Creek, Upper	MUN, AGR, PROC, IND, FRESH, REC-1, REC-2, WARM, COLD, WILD, SPWN
Coastal water	Pacific Ocean Shoreline	IND, NAV, REC-1, REC-2, COMM, BIOL, WILD, RARE, MAR, AQUA, MIGR, SPWN, SHELL

[a] The waterbody is exempted by the Regional Board under terms and conditions of State Board Resolution 88-63, *Sources of Drinking Water* Policy.
[b] This use is listed as a potential beneficial use.
Source: Regional Board, 1994.

Table 2-2. Bacteria Water Quality Objectives

Designated Use	Bacteria Type	Water Quality Objectives
SHELL	30-DAY	
	Total coliform bacteria	The median concentration throughout the water column for any 30-day period shall not exceed 70/100 mL
	SINGLE SAMPLE	
	Total coliform bacteria	No more than 10 percent of the samples collected during any 30-day period shall exceed 230/100 mL for a five-tube decimal dilution test or 330/100 mL for a three-tube decimal dilution test
REC-1	30-DAY	
	Total coliform bacteria	Not more than 20 percent of the samples at any sampling station, in a 30-day period, may exceed 1,000/100 mL
	Fecal coliform bacteria	Based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200/100 mL
	Enterococci	The geometric mean shall not exceed 35/100 mL for salt water, and 33/100 mL for fresh water
	SINGLE SAMPLE	

	Total coliform bacteria	No sample shall exceed 10,000/100 mL
	Fecal coliform bacteria	No more than 10 percent of total samples during any 30-day period shall exceed 400/100 mL
	Enterococci	Shall no exceed 61/100 mL in fresh water, and 104/100 mL

Source: SDRWQCB, 1994.

4 Numeric Target Selection

When calculating TMDLs, numeric targets are established to meet water quality objectives and ensure the protection of beneficial uses. The TMDL calculations are based on the Basin Plan WQOs for REC1 (FC and ENT) and SHELL (TC) (Table 2-2). In addition, interim targets for wet weather are presented that account for contributions from natural background, termed a "reference watershed approach."

In areas where background sources of bacteria (e.g., bird or wildlife waste) can, by themselves, result in non-attainment of Basin Plan WQOs, it is often useful to compare the watershed to a reference watershed representative of natural conditions. The reference approach ensures that water quality objectives are at least as good as conditions observed at a reference watershed, while accounting for the impact of natural sources on water quality. Furthermore, the approach ensures no further bacteriological degradation of water quality where existing conditions are better than the reference watershed. This approach has been used by the Los Angeles Regional Water Quality Control Board (LA Regional Board) for developing bacteria TMDLs for Malibu Creek and the Santa Monica Bay beaches (LA Regional Board, 2002, and 2003).

In Los Angeles the reference watershed approach was used to identify the numeric targets, which were expressed as a number of days of allowable exceedance of the single-sample WQO. The use of the reference approach requires amendment of the Basin Plan. The following language is from the LA Regional Board Basin Plan amendment referenced for TMDL development of the Santa Monica Bay beaches and Malibu Creek:

> The single sample bacteriological objectives shall be strictly applied except when provided for in the Total Maximum Daily Load (TMDL). In all circumstances, including in the context of a TMDL, the geometric mean objectives shall be strictly applied. In the context of a TMDL, and at the discretion of the Regional Board, implementation of the single sample objectives in fresh and marine waters may be accomplished by using a 'reference system/antidegredation approach' or 'natural sources exclusion approach.' A reference system is defined as an area and associated monitoring point that is not impacted by human activities that potentially affect bacteria densities in the receiving water body.
>
> These approaches recognize that there are natural sources of bacteria, which may cause or contribute to exceedances of the single sample objectives for bacterial indicators. They also acknowledge that it is not the intent of the Regional Board to require treatment of natural sources of bacteria from undeveloped areas. Such requirements, if imposed by the Regional Board, could adversely affect valuable aquatic life and wildlife beneficial uses supported by natural water bodies in the Region.
>
> Under the reference system/antidegradation implementation procedure, a certain frequency of exceedance of the single sample objectives above shall be permitted on the basis of the observed exceedance frequency in the reference system or the

> targeted water body, whichever is less. The reference system/antidegradation approach ensures that bacteriological water quality is at least as good as that of the reference system and that no degradation of existing bacteriological water quality is permitted where existing bacteriological water quality is better than that of the selected reference system.
>
> Under the natural sources exclusion implementation procedure, after all anthropogenic sources of bacteria have been controlled such that they do not cause an exceedance of the single sample objectives, a certain frequency of exceedance of the single sample objectives shall be permitted based on the residual exceedance frequency in the specific water body. The residual exceedance frequency shall define the background level of exceedance due to natural sources. The 'natural sources exclusion' approach may be used if an appropriate reference system cannot be identified due unique circumstances of the target water body. These approaches are consistent with the State Antidegradation Policy (State Board Resolution No. 68-16) and with federal antidegradation requirements (40 CFR 131.12).
>
> The appropriateness of these approaches and the specific exceedance frequencies to be permitted under each will be evaluated within the context of TMDL development for a specific waterbody, at which time the Regional Board may select one of these approaches, if appropriate.

The reference approach has been incorporated into the calculations in this document. Specifically, this document includes assessment of allowable exceedance frequencies of water quality objectives during wet-weather conditions. The reference approach is presented in this document because it provides an interim goal for achieving WQOs.

4.1 Reference Watershed

For the San Diego Region, the San Mateo Creek watershed (Figure 2-1), just south of the San Juan Creek and San Clemente watersheds, was identified as the best candidate for assessment of natural background sources of bacteria. Most of this watershed is open space (95 percent); minor areas are associated with agriculture (2 percent) and low-density residential (1 percent). The remaining land uses, which contribute less than 2 percent of the total area, include high-density residential, commercial/institutional, industrial/transportation, parks/recreation, open recreation, horse ranches, and transitional.

The County of San Diego Department of Environmental Health collected bacteria data at two stations located near the mouth of San Mateo Creek from 1999 through 2002. The monitoring data were separated based on their association with wet or dry conditions to better understand bacteria concentration variability during periods when sources of bacteria differ (wet weather runoff verses dry weather runoff). The wet period was defined to be consistent with the California Department of Environmental Health's General Advisory to avoid contact with ocean and bay water within 300 feet on either side of any storm drain, river, or lagoon outlet, and it is designated as 72 hours after 0.2 inch or more of rain. For each monitoring station, sampling dates were compared to rainfall data collected at the closest rainfall gage (ALERT21) to determine whether bacteria samples had been collected during wet or dry periods. Once the data for all stations were designated as wet or dry samples, they were compared to single sample WQOs for FC, TC, and ENT at each station (Tables 2-3 and 2-4).

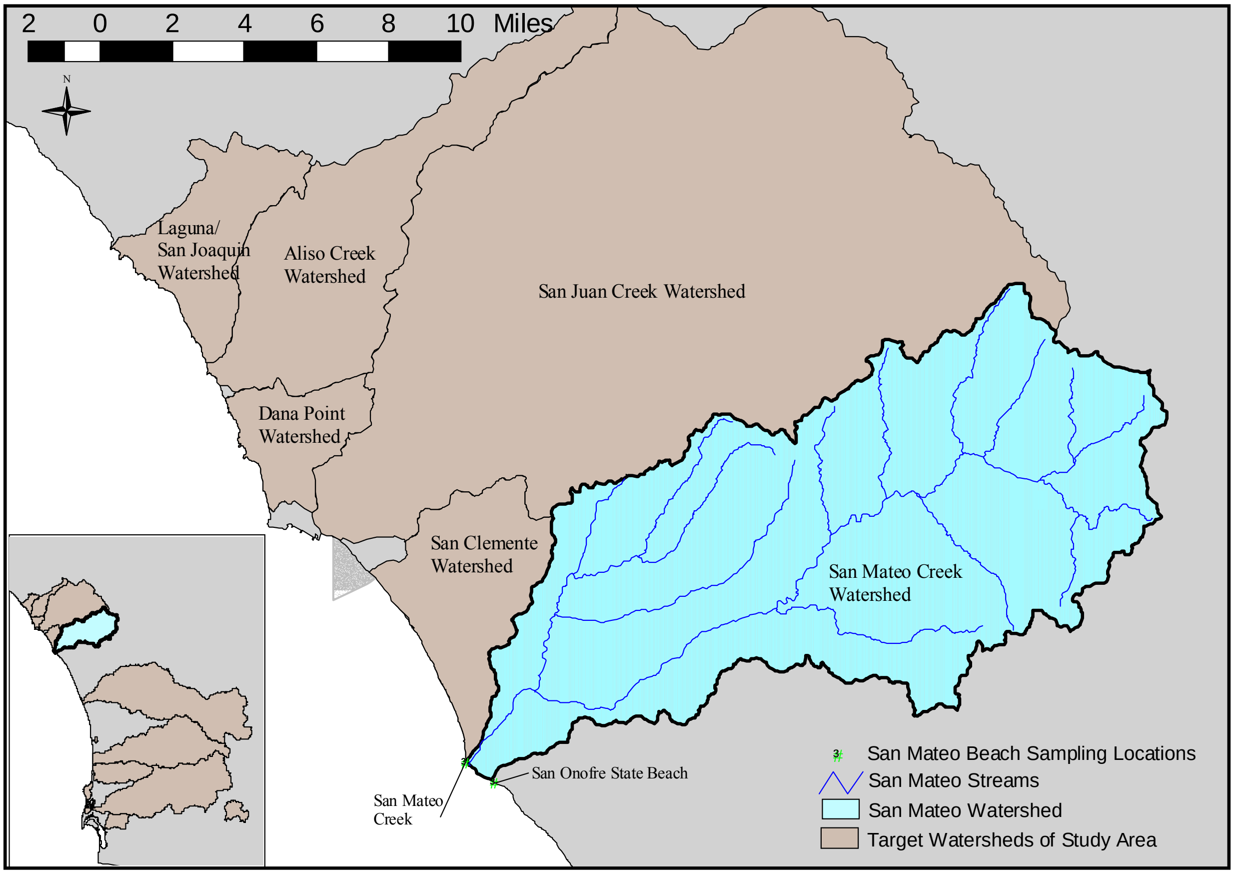

Figure 2-1. San Mateo watershed (reference watershed).

Table 2-3. Reference Watershed Wet Weather Exceedances

Site ID	Location	Number of wet weather samples	Number of wet weather exceedances	Wet weather exceedance probability
		Fecal Coliform		
EH-520	San Mateo Creek	6	2	33%
EH-510	San Onofre State Beach	5	2	40%
		Total Coliform		
EH-520	San Mateo Creek	6	1	17%
EH-510	San Onofre State Beach	5	1	20%
		Enterococcus		
EH-520	San Mateo Creek	6	3	50%
EH-510	San Onofre State Beach	5	2	40%

Table 2-4. Reference Watershed Dry Weather Exceedances

Site ID	Location	Number of dry weather samples	Number of dry weather exceedances	Dry weather exceedance probability
		Fecal Coliform		
EH-520	San Mateo Creek	101	0	0%
EH-510	San Onofre State Beach	72	0	0%
		Total Coliform		
EH-520	San Mateo Creek	100	0	0%
EH-510	San Onofre State Beach	72	0	0%
		Enterococcus		
EH-520	San Mateo Creek	101	3	3%
EH-510	San Onofre State Beach	72	1	1%

4.2 Dry-Weather Targets

Most of the bacteria data were collected at the mouth of San Mateo Creek during dry periods: 101 samples were collected at San Mateo Creek (EH-520), and 72 were collected at San Onofre State Beach (EH-510). During dry conditions WQOs were attained for FC and TC. For ENT, 3 percent of samples exceeded the WQOs at San Mateo Creek and 1 percent exceeded them at San Onofre State Beach. Results of dry-weather monitoring data for the reference watershed suggest that exceedances of WQOs are uncommon during such conditions. Therefore, WQOs are sufficient for use as TMDL targets, with no exceptions or exceedances determined allowable to meet reference conditions.

Dry-weather TMDL targets for FC and ENT for all surface waters were based on WQOs specific to the REC-1 beneficial use. For total coliform, dry-weather TMDL targets were based on WQOs specific to the REC-1 beneficial use for creeks, and the SHELL use for beaches, coastal lagoons, and creeks discharging to coastal waters. Due to the stringency of the SHELL WQOs, interim targets based on REC-1 WQOs were developed to provide adequate time for further investigation of the appropriateness of the SHELL use for these waterbodies.

4.3 Wet-Weather Targets

Limited data was available for the assessment of background conditions associated with wet periods. Six samples were collected at San Mateo Creek, and five were collected at San Onofre State Beach (EH-510). The limited data set precluded a detailed assessment of background conditions and the development of a revised interpretation of WQOs. However, comparison of water quality data to WQOs for each of the indicator bacteria confirmed the necessity for considering natural sources of bacteria and impacts on waterbodies.

The LA Regional Board used the Arroyo Sequit watershed as the reference watershed for development of TMDLs at the Santa Monica Bay beaches and Malibu Creek (LA Regional Board, 2002, and 2003). This watershed, consisting primarily of natural land use (98 percent open space), discharges to Leo Carillo Beach, where 19 percent of wet-weather FC data (9 out of 48 samples) were observed to exceed the WQOs.

Until more wet-weather data are collected at the mouth of San Mateo Creek or another suitable reference watershed is identified for the San Diego region, the conditions observed at Arroyo Sequit will be used as an interim TMDL target and the Basin Plan WQOs will remain the TMDL targets. This phased implementation approach is consistent with federal and state regulations, policy, and guidance. When additional data are collected for San Mateo Creek or another candidate reference watershed, that allow a more accurate determination of allowable exceedance frequencies characteristic of natural conditions in the San Diego Region, the TMDL can be revised to better reflect natural conditions in the watersheds.

5 Data Inventory and Analysis

Data from numerous sources were used to characterize the watersheds and water quality conditions, identify bacteria sources, and support the calculation of TMDLs for the watersheds. No new data were collected as part of this effort. The data analysis provided an understanding of the conditions that result in impairments.

5.1 Data Inventory

The categories of data used in developing these TMDLs include physiographic data that describe the physical conditions of the watershed and environmental monitoring data that identify past and current conditions and support the identification of potential pollutant sources. Table 3-1 presents the various data types and data sources used in the development of these TMDLs. The following sections describe the key data sets used for TMDL development.

5.1.1 Water Quality Data

Monitoring data for the impaired beaches were received from a number of agencies in San Diego and Orange County. Data were received for 52 locations monitored along listed shorelines, in addition to 7 unimpaired shoreline locations (Figures 3-1 and 3-2). Bacteria data (including FC, TC, and ENT) were collected at various times from 1999 through 2002, and the amount of data varied among monitored locations. Most locations had FC, TC, and ENT data for assessment of existing conditions.

Special studies were conducted for Aliso Creek and San Juan Creek (Regional Board, 2002) by the Orange County Public Facilities and Resources Department and the Orange County Public Health Laboratory, respectively (Figure 3-3). The City of San Diego conducted studies of Rose Creek and Tecolote Creek (Figure 3-4 data were collected in 2001—2002, and the project is scheduled for completion in June 2004). For each of the studies, multiple bacteria samples were collected throughout the year at stations throughout the watersheds and along several tributaries.

In addition, monitoring data were obtained for the following five rivers or creeks from various entities in the region: San Diego River (Padre Dam Municipal Water District), San Mateo Creek (Southwest Division Naval Facilities Engineering Command), Santa Margarita River (Southwest Division Naval Facilities Engineering Command), San Luis Rey River (City of Oceanside), and Pine Valley Creek (City of San Diego, Water Department, Cleveland National Forest–Descanso Ranger District).

Water quality data from six major inland dischargers—five at Camp Pendelton and one on Murrietta Creek (Santa Rosa Water Reclamation Facility)—were obtained. All these sources are in the Santa Margarita River watershed. Discharge data for inland outfalls to streams are limited to the period prior to 2002, after which all major inland discharges were either discontinued or diverted to ocean outfalls.

Table 3-1. Inventory of Data and Information Used for the Source Assessment of Bacteria

Data Set	Type of Information	Data Source(s)
Watershed physiographic data	Location of dams	USEPA BASINS
	Stream network	USEPA BASINS (Reach File, Versions 1 and 3); USGS National Hydrography Dataset (NHD) reach file; special studies of Aliso Creek, Tecolote Creek, and Rose Creek.
	Land use	USGS MRLC (1993); San Diego Regional Planning Agency – 2000 land use coverage for San Diego County (SANDAG); Southern California Association of Governments (SCAG) land use coverage of Orange and portions of Riverside Counties (1993)
	Counties	USEPA BASINS
	Cities/populated places	USEPA BASINS, U.S. Census Bureau's Tiger Data
	Soils	USEPA BASINS (USDA-NRCS STATSGO)
	Watershed boundaries	USEPA BASINS (8-digit hydrologic catalogoing unit); CALWTR 2.2 (1995)
	Topographic and digital elevation models (DEMs)	USEPA BASINS; USGS
Environmental monitoring data	Water quality monitoring data	USEPA's STORET; California Department of Environmental Health; County of San Diego Department of Environmental Health; Orange County Pubic Facilities and Resources Department; City of San Diego; City of Oceanside; Orange County Public Health Laboratory, Regional Board; Padre Dam Municipal Water District; Southwest Division Naval Facilities Engineering Command
	Streamflow data	USGS; Orange County Public Facilities and Resources Department; City of San Diego
	Meteorological station locations	BASINS; National Oceanic and Atmospheric Administration - National Climatic Data Center (NOAA-NCDC); California Irrigation Management Information System (CIMIS); California Department of Water Resources, Division of Flood Management; ALERT (Automatic Local Evaluation in Real-Time) Flood Warning System

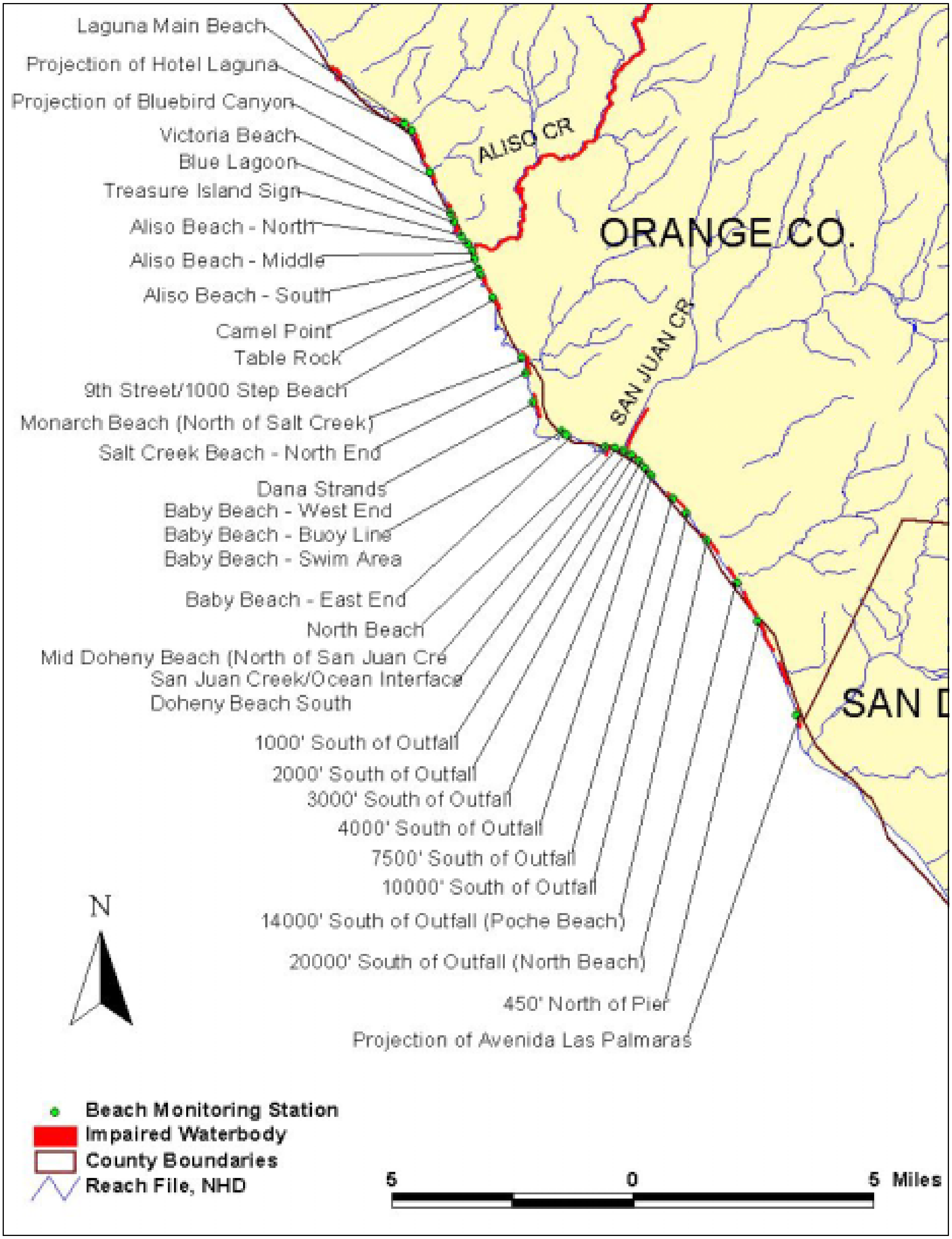

Figure 3-1. Beach monitoring station locations in Orange County.

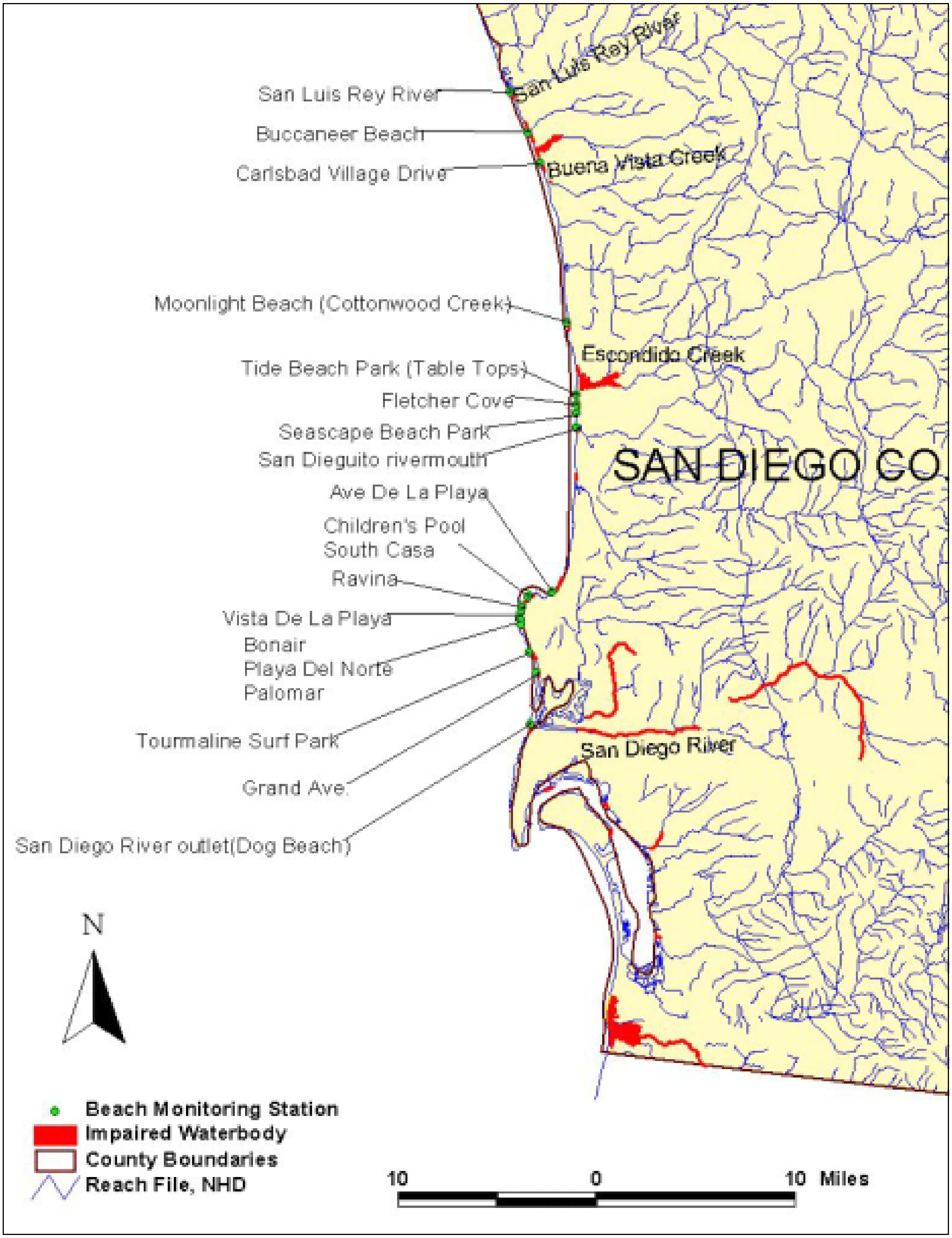

Figure 3-2. Beach monitoring station locations in San Diego County.

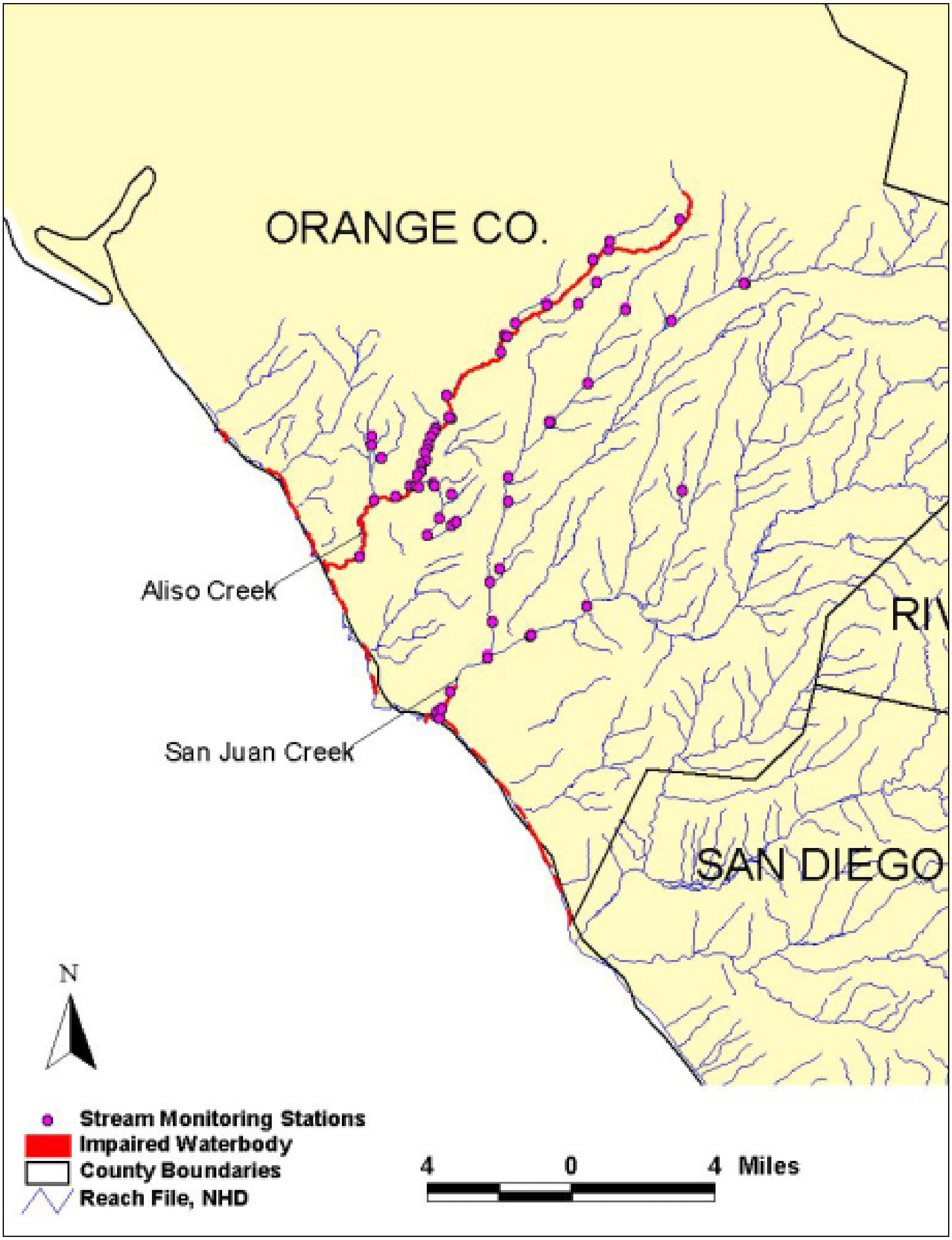

Figure 3-3. Bacteria monitoring stations on Aliso Creek and San Juan Creek.

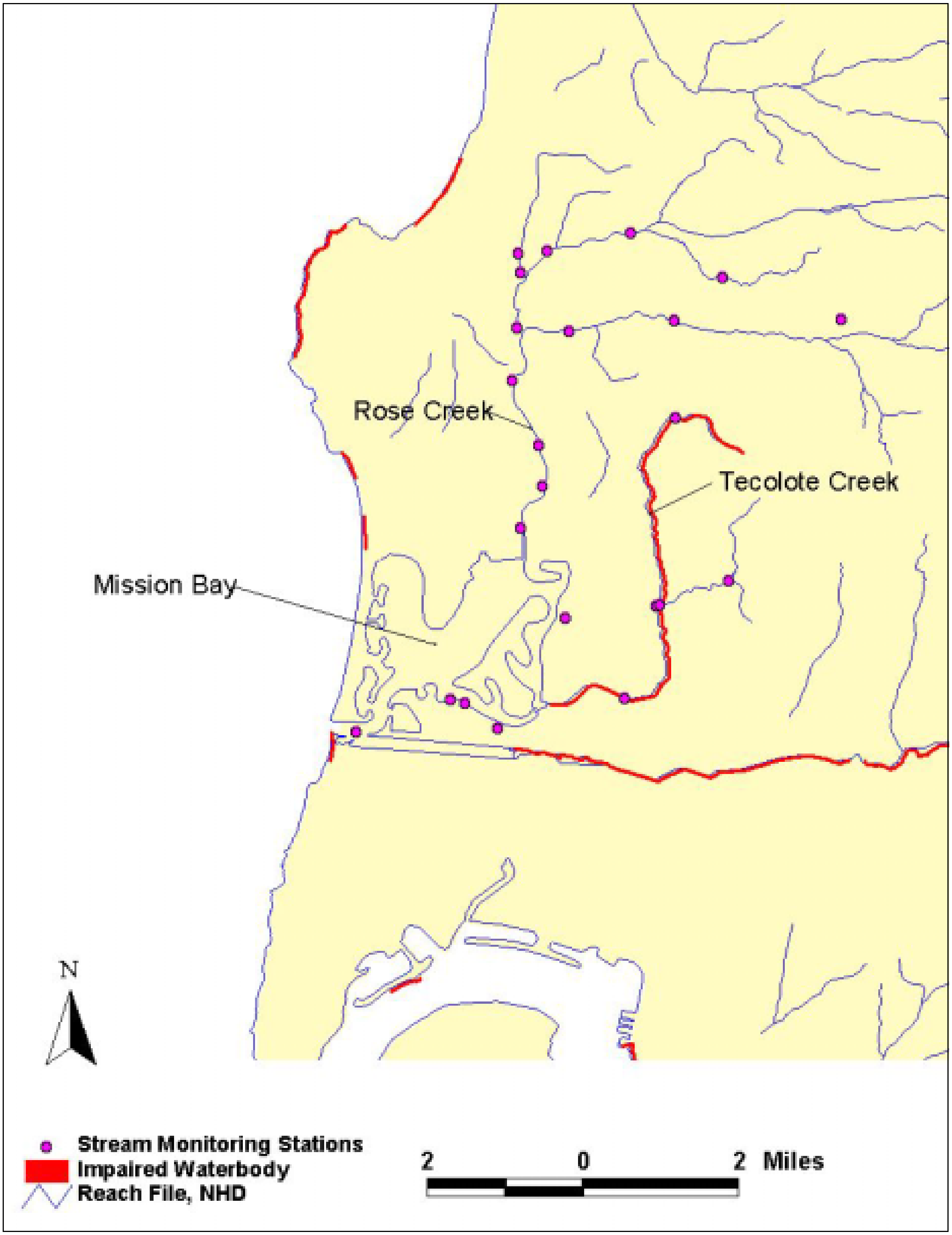

Figure 3-4. Bacteria monitoring stations on Rose Creek and Tecolote Creek.

5.1.2 Waterbody Characteristics

The assessment of waterbody characteristics involved analyzing streamflow data and assessing physical information. This information was used to determine the volume and hydraulic features of waterbodies for determining assimilative capacity and physical processes that affect bacteria transport for TMDL analysis.

A limited amount of streamflow data for the listed segments was available. The Aliso Creek, Rose Creek, and Tecolote Creek watersheds had streamflow information associated with special studies performed for the assessment of bacteria loading characteristics (see Section 3.1.1). In addition, U.S. Geological Survey (USGS) with recent streamflow records gages were identified in the study area (Table 3-2). Historical streamflow data and data for stream channel geometry (width and depth) for these gages were obtained from USGS.

Table 3-2. USGS Streamflow Gages in the San Diego Region with Recent Data

Station Number	Station Name	Historical Record
11022480	San Diego River at Mast Road near Santee, CA	5/1/1912–9/30/2002
11023000	San Diego River at Fashion Valley at San Diego, CA	1/18/1982–9/30/2002
11023340	Los Penasquitos Creek near Poway, CA	10/1/1964–9/30/2002
11025500	Santa Ysabel Creek near Ramona, CA	2/1/1912–9/30/2002
11028500	Santa Maria Creek near Ramona, CA	12/1/1912–9/30/2002
11042000	San Luis Rey River at Oceanside, CA	10/1/1912–11/10/1997; 4/29/1998–9/30/2002
11042400	Temecula Creek near Aguanga, CA	8/1/1957–9/30/2002
11044300	Santa Margarita River at FPUD Sump near Fallbrook, CA	10/1/1989–9/30/2002
11046000	Santa Margarita River at Ysidora, CA	3/1/1923–2/25/1999; 10/1/2001–9/30/2002
11046530	San Juan Creek at La Novia Street Bridge near San Juan Capistrano, CA	10/1/1985–9/30/2002
11047300	Arroyo Trabuco near San Juan Capistrano, CA	10/1/1970–9/30/1989; 10/1/1995–9/30/2002
11022350	Forester Creek near El Cajon, CA	10/1/1993–9/30/2002
11039800	San Luis Rey River at Couser Canyon Bridge near Pala, CA	10/1/1986–1/4/1993

5.1.3 Meteorological Data

Hourly rainfall data were obtained from the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA). To augment the NCDC data, hourly rainfall data were also obtained from the California Irrigation Management Information System (CIMIS); California Department of Water Resources, Division of Flood Management; and the ALERT (Automatic Local Evaluation in Real-Time) Flood Warning System. In addition, hourly evapotranspiration data were obtained from CIMIS.

5.1.4 Land Characteristic Data

Available land use data to support this study included the 1993 USGS Multi-Resolution Land Characteristic (MRLC) data, which were available for the entire study area. The San Diego Regional Planning Agency (SANDAG) had a more detailed and recent 2000 land use data set that covers San Diego County. For Orange County and portions of Riverside County, land use data were obtained from the Southern California Association of Governments (SCAG). A combination of MRLC, SANDAG, and SCAG data was used to provide the most complete and up-to-date land use representation of the region.

In additionally, soil data were obtained from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) State Soil Geographic (STATSGO) database and topographic information was obtained from USEPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) system.

5.2 Review of Impairments

Bacteria data collected from beach and creek segments were analyzed to provide guidance for the source assessment. Results of these analyses are reported in the following sections.

5.2.1 Beach Impairments

Bacteria monitoring data for beach stations were analyzed to provide insight into the spatial extent of impairment and the timing of any exceedances of WQOs. Results of this analysis were also used in the source assessment to identify the proximity of listed coastal segments to tributaries, outfalls, and other potential sources (see Section 4). Monitoring data were reviewed based on their association with wet or dry conditions (see Section 2.3.1) to better understand variability during periods when methods of transport differ (wet weather runoff versus dry weather runoff). The wet period was defined to be consistent with the California Department of Environmental Health's General Advisory to avoid contact with ocean and bay water within 300 feet on either side of any storm drain, river, or lagoon outlet, and it is designated as 72 hours after 0.2 inch or more of rain. For each monitoring station, sampling dates were compared to rainfall data collected at the closest rainfall gage to determine whether bacteria samples had been collected during wet or dry periods. Once the data for all stations were identified as wet or dry, the number of exceedances of single sample WQOs was quantified for FC, TC, and ENT at each station (not enough data were available for assessment of compliance to 30-day geometric mean WQOs; see Section 2.1).

To assess the spatial variability of bacteria levels during both wet and dry conditions, the exceedance frequency of the REC-1 (FC and ENT) and SHELL (TC) single sample WQO for each station is shown for FC, TC, and ENT in Figures B-1 through B-6 of Appendix B. Results show that at some locations, bacteria concentrations frequently exceed the WQOs for indicator bacteria. The frequency of exceedances varies for each indicator bacteria, location, and wet or dry weather conditions. Also, higher exceedance frequencies are observed in the vicinity of creeks or lagoons and major stormwater outfalls, especially at the mouths of those creeks and lagoons listed as impaired due to bacteria.

5.2.2 Creek Impairments

The analysis of beach monitoring data confirms that the highest number of exceedances of WQOs was in the vicinity of rivers, major stormwater outfalls, and known local sources (e.g., waterfowl at lagoons). This analysis is important in review of creek impairments because high numbers of exceedances were observed at the mouths of Aliso Creek, San Juan Creek, and the San Diego River. Tables 3-3 through 3-5 list the number of monitoring stations and observed data, ranges of indicator bacteria levels observed, and exceedance frequencies of WQOs in the watershed of each impaired creek where data was available and respective indicator bacteria were listed as the pollutant/stressor (see Appendix A). For each impaired watershed, exceedances of WQOs were observed.

Table 3-3. Summary of Fecal Coliform Data for Impaired Creeks

Stream	Number of Monitoring Stations	Total Number of Samples	Fecal Coliforms (MPN/100mL)			Frequency of Exceedance of WQOs
			Minimum	Mean	Maximum	
Aliso Creek	108	8,816	2	10,739	684,600	77%
San Diego River	6	36	2	1,557	24,000	36%
San Juan Creek	31	357	10	5,680	350,000	58%

Table 3-4. Summary of Total Coliform Data for Impaired Creeks

Stream	Number of Monitoring Stations	Total Number of Samples	Total Coliform (MPN/100 mL)			Frequency of Exceedance of WQOs
			Minimum	Mean	Maximum	
Aliso Creek	108	8,815	2	40,750	878,400	55%
San Diego River	6	34	300	14,885	300,000	15%
San Juan Creek	31	357	10	130,683	14,900,000	45%

Table 3-5. Summary of Enterococcus Data for Impaired Creeks

Stream	Number of Monitoring Stations	Total Number of Samples	Enterococcus (MPN/100 mL)			Frequency of Exceedance of WQOs
			Minimum	Mean	Maximum	
Aliso Creek	108	8,817	1	6,018	492,800	98%
Pine Valley Creek	4	78	1	348	20,000	15%
San Juan Creek	31	357	5	4,834	280,000	89%

5.3 Analyses of Beach Water Quality Versus Magnitude of Streamflow

A statistical comparison of flow versus bacteria density was also performed to evaluate historical effects of high- and low-flow events near the mouths of the creeks. Two USGS gage stations in close proximity to the monitoring locations had flow data for the same time period as the bacteria monitoring data: San Diego River–Dog Beach (USGS 11023000 and FM-010) and San Luis Rey River (USGS 11042000 and OC-100). Figures 3-5 and 3-6 show the flow versus bacteria density comparisons. In general, high bacteria levels were observed under a range of flow conditions, indicating the need to assess of bacteria sources during both wet and dry weather periods.

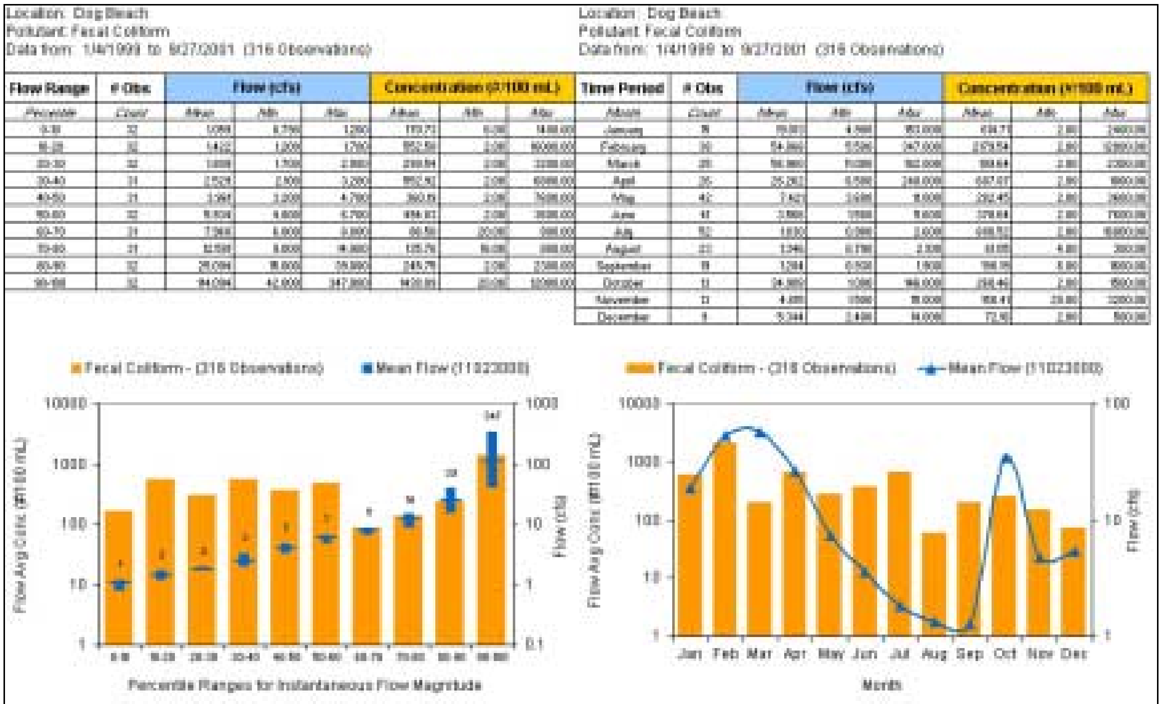

Figure 3-5. Flow versus concentration comparisons near San Diego River outlet (Dog Beach).

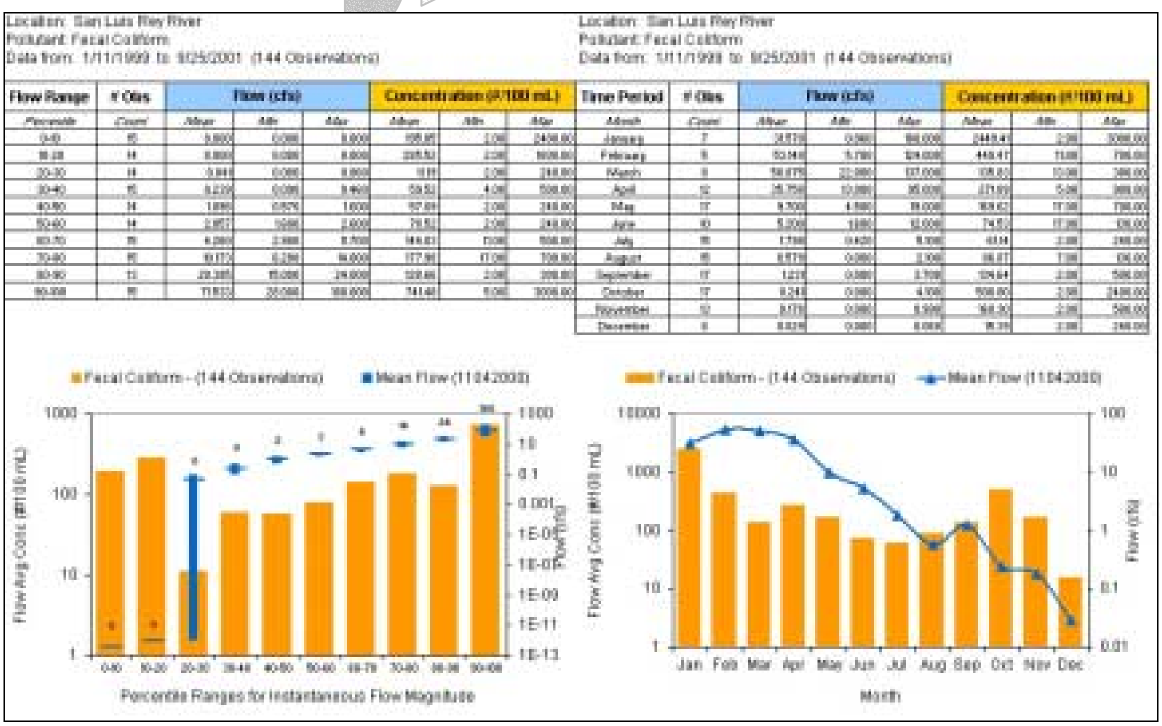

Figure 3-6. Flow versus concentration comparisons near San Luis Rey River.

6 Source Analysis

This section presents the approach used to identify and quantify the sources of bacteria to impaired beaches and creeks. Both in-stream and watershed data were used to identify potential sources and characterize the relationship between point and nonpoint source loadings and in-stream response under wet and dry conditions. Bacteria enter surface waters from both point and nonpoint sources. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels from municipal wastewater treatment plants, industrial waste treatment facilities, or Municipal Separate Storm Sewer System (MS4) permitted stormwater discharges. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters. During wet and dry periods multiple nonpoint sources of bacteria contribute to overall loads to the impaired waterbodies. These sources include sewer line breaks, illegal sewage disposal from boats along the coastline, encampments of homeless persons, or direct input to waterbodies from waterfowl or other animals. Because the relative loads from these sources vary depending on wet or dry conditions, assessment of loads requires separate analyses.

6.1 Nonpoint Sources

The following sections explain how loadings from the nonpoint sources identified as contributors of bacteria to surface waters were incorporated into the TMDL calculations.

6.1.1 Natural Background (Aquatic and Terrestrial Wildlife)

Direct input of animal waste to waterbodies is a significant source of bacteria during both wet and dry conditions. Studies have shown that bacteria from waterfowl can potentially contribute significant loads of bacteria to coastal waters (Fleming and Fraser, 2001; Grant et al., 2001). In the San Diego region, coastal lagoons are frequented by large populations of waterfowl that contribute feces directly to the water surface or to the low-lying mud flats in the marsh that become submerged during high tides. Such bacteria loads can be transported to the beaches during tidal fluctuations or during wet weather flows. Waterfowl and marine mammals (such as seals) have also been observed at impaired beaches in numbers that suggest they could represent significant contributors of bacteria.

For impaired beaches, the critical point for TMDL calculations was at the mouth of the contributing waterbody; therefore contributions from animal feces in the surf zone did not require quantification. During implementation of the TMDLs, if exceedances of WQOs continue after anthropogenic sources in the watersheds are reduced, a natural source exclusion to address animal sources can be investigated. Children’s Pool, a beach frequented by seals, would be a candidate site for such an investigation should continued exceedances of WQOs be observed following reduction of bacteria loads from stormwater runoff.

Although natural background is a significant source of bacteria, it is largely considered uncontrollable. The reference approach allows for incorporation of natural bacteria sources into each of the distinct waste load allocations (See section 8.1.5). Instead of quantifying an allowable contribution of natural sources of bacteria to the watershed (allocation), a practice that is usually done during TMDL development, these contributions were absorbed into each waste load allocation developed for each impaired watershed.

6.1.2 Encampments

During rainfall events, wash-off from encampments of homeless persons can potentially contribute elevated bacteria loads to waterbodies due to improper disposal of human waste. Such contributions are extremely difficult to quantify from analysis of individual encampment populations. Rather, loads from such encampments were considered to be included within urban runoff characterized through the watershed modeling analysis of wet weather conditions (see Section 5.2 and Appendix C). Urban runoff from these areas was considered along with stormwater and was categorized as point sources discharges through MS4 stormwater permits (see Section 4.2).

If bacteria loads from encampments of homeless persons result from direct discharge of human feces to the waterbodies, the loads are assumed to receive a 100 percent reduction for implementation of the TMDL. Direct discharges were not included explicitly in TMDL calculations.

6.2 Point Sources

A point source, according to 40 CFR 122.3, is defined as "any discernable, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged." The National Pollutant Discharge Elimination System (NPDES) Program, under Clean Water Act sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources.

6.2.1 Wastewater Treatment Plants

There are no direct point source discharges of bacteria to waterbodies in the San Diego Region. Wastewater treatment plants (WWTPs) are active in the watershed; however, all effluent from these facilities is discharged from offshore ocean outfalls.

Bacteria loads also periodically occur as a result of sewage spills. Although these loads potentially result in contamination of the waterbodies and bacterial concentrations that exceed WQOs, the loads attributed to these sources were not quantified for TMDL development. Because loads from sewage spills are accidental, estimation of the load reductions required to meet TMDLs is not required. Rather, all loads from sewage spills are assumed to receive a 100 percent reduction for implementation of the TMDL.

6.2.2 Urban Runoff

In 1990 USEPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent harmful pollutants from being washed by stormwater runoff into MS4s (or from being dumped directly into the MS4s) and then discharged from the MS4 into local waterbodies. Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement a stormwater management program as a means to control polluted discharges from MS4s. Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations, and hazardous waste treatment. Large and medium operators are required to develop and implement Stormwater Management Plans that address, at a minimum, the following elements:

- Structural control maintenance
- Areas of significant development or redevelopment
- Roadway runoff management
- Flood control related to water quality issues
- Municipally owned operations such as landfills, wastewater treatment plants, etc.
- Hazardous waste treatment, storage, or disposal sites, etc.
- Application of pesticides, herbicides, and fertilizers
- Illicit discharge detection and elimination
- Regulation of sites classified as associated with industrial activity
- Construction site and post-construction site runoff control
- Public education and outreach

Phase II of the rule extends coverage of the NPDES stormwater program to certain small municipalities with a population of at least 10,000 and/or a population density of more than 1,000 people per square mile. A small MS4 is defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES Storm Water Program.

For the San Diego Region, all discharges of urban runoff are covered by MS4 permits. For the watersheds of San Diego County, the incorporated cities of San Diego County (18 cities), and the San Diego Unified Port District, NPDES No. CAS0108758 defines the waste discharge requirements for MS4s. For the watersheds of Orange County, the incorporated cities of Orange County (11 cities), and the Orange County Flood Control District, NPDES No. CAS0108740 defines the waste discharge requirements for MS4s. Urban runoff discharges from MS4s are a leading cause of receiving water quality impairments in the San Diego Region. A direct linkage has been established between human illness and recreating near the outfalls of urban storm drains (SDRWQCB, 2001, and 2002).

<u>4.2.2.a Wet-Weather Urban Runoff</u>

Wash-off of bacteria from various land uses is considered the primary source of bacteria during wet conditions due to the relatively large bacteria levels observed at the mouths or within the watershed of impaired creeks during wet conditions. After bacteria build up on the surface as the result of various land use sources and associated management practices (e.g., management of livestock in agricultural areas, pet waste in residential areas), many of the bacteria are washed off the surface during rainfall events. The amount of runoff and associated bacteria concentrations are therefore highly dependent on land use.

To estimate bacteria sources from runoff during wet events, a watershed model was developed (Appendix C). For assessment of bacteria loads from various land use sources, a critical wet year, based on the 92nd percentile wet year (1993) over a 12-year period from 1990 through 2002, was simulated using the watershed model. The critical wet year was used to simulate of critical conditions for calculating of the TMDLs.

4.2.2.b Dry-Weather Urban Runoff

From analysis of spatial distributions of bacteria concentrations along the Pacific Ocean shoreline, high bacteria levels were observed at the mouths of major stormwater outfalls and creeks under dry conditions (see Section 3.2 and Appendix B). This observance was validated through an analysis of streamflow versus bacteria concentration that indicated a significant dry-weather source to streams. During dry conditions, most impaired streams exhibit a sustained baseflow even if no rainfall has occurred for a significant period to provide runoff or groundwater flows. These flows are generally understood to result from various urban land use practices that cause water to enter storm drains and creeks. Such practices include lawn irrigation runoff, car washing, sidewalk washing, and the like. As these flows travel across lawns and urban surfaces, bacteria are carried from these areas to the receiving waterbody.

Analysis of studies performed at Aliso Creek, San Juan Creek, Tecolote Creek, and Rose Creek found that dry urban runoff and associated bacteria levels could be estimated from land use information in a given watershed. This analysis is discussed in detail in Appendix I.

7 Linkage Analysis

The technical analysis of bacteria loading and the waterbody response to this loading is referred to as the linkage analysis. The analysis results in the calculation of the total allowable bacteria loading to the impaired waterbodies and the associated reductions in current loading from individual controllable sources needed to meet water quality standards. Because the TMDL final numeric targets are set equal to the numeric water quality objectives for bacteria, attainment of the numeric targets will result in attainment of water quality standards.

For these TMDLs, a distinction is made between wet and dry weather conditions because the sources and amounts of bacteria vary between the two scenarios and implementation measures will be specific to these conditions.

7.1 Model Selection

In selecting an appropriate approach for TMDL calculation, technical and regulatory criteria were considered. Technical criteria include the physical system in question, including watershed or stream characteristics and processes and the constituent of interest. Regulatory criteria include water quality objectives or procedural protocol. The following discussion details the considerations in each of these categories.

7.1.1 Technical Criteria

Technical criteria are divided into four main topics. Consideration of each topic was critical in selecting the most appropriate modeling system to address the types of sources and the numeric targets associated with the listed waters.

<u>5.1.1.a Physical Domain</u>

Representation of the physical domain is perhaps the most important consideration in model selection. The physical domain is the focus of the modeling effort—typically, either the receiving water itself or a combination of the contributing watershed and the receiving water. Selection of the appropriate modeling domain depends on the constituents and the conditions under which the stream exhibits impairment. For a stream dominated by point source inputs that exhibits impairments under only low-flow conditions, a steady-state approach is typically used. This type of modeling approach focuses on only in-stream (receiving water) processes during a user-specified condition. For streams affected additionally or solely by nonpoint sources or primarily rainfall-driven flow and pollutant contributions, a dynamic approach is recommended. Dynamic watershed models consider time-variable nonpoint source contributions from a watershed surface or subsurface. Some models consider monthly or seasonal variability, while others enable assessment of conditions immediately before, during, and after individual rainfall events. Dynamic models require a substantial amount of information regarding input parameters and data for calibration purposes. It was assumed that the San Diego Region is dominated by nonpoint sources that are generally constant on an hourly time step and deposit directly to drains.

Although the sources are nonpoint in nature, their behavior in the stream is more like that of a point source.

5.1.1.b Source Contributions

Primary sources of pollution to a waterbody must be considered in the model selection process. Accurately representing contributions from nonpoint sources and permitted point sources is critical in properly representing the system and ultimately evaluating potential load reduction scenarios.

Water quality monitoring data were not sufficient to fully characterize all sources of bacteria in the listed watersheds. However, analyses of the available data indicate that the main sources are dry- and wet-weather urban runoff. As a result, the models selected to develop bacteria TMDLs for beaches and creeks need to address the major source categories during wet and dry conditions considered controllable for TMDL implementation purposes.

5.1.1.c Critical Conditions

The goal of the a TMDL analysis is to determine the assimilative capacity of a waterbody and to identify potential allocation scenarios that will enable the waterbody(ies) to achieve WQOs. The critical condition is the set of environmental conditions for which controls designed to protect water quality will ensure attainment of objectives for all other conditions. This is typically the period of time in which the waterbody exhibits the most vulnerability. In the watersheds of the San Diego Region, separate critical conditions were identified for wet and dry conditions.

5.1.1.d Constituents

Another important consideration in model selection and application is the constituent(s) to be assessed. Choice of state variables is a critical part of model implementation. The more state variables included, the more difficult the model will be to apply and calibrate. However, if key state variables are omitted from the simulation, the model might not simulate all necessary aspects of the system and might produce unrealistic results. A delicate balance must be met between minimal constituent simulation and maximum applicability.

The focus of development of this TMDL is on FC, TC, and ENT. Factors affecting the survival of bacteria include soil moisture content, pH, solar radiation, and available nutrients. In-stream bacteria dynamics can be extremely complex, and accurate estimation of bacteria concentrations relies on a host of interrelated environmental factors. Bacteria concentrations in the water column are influenced by die-off, regrowth, partitioning of bacteria between water and sediment during transport, settling, and resuspension of bottom materials. First-order die-off is likely the most important dynamic to simulate in the San Diego Region. The limited data available provide few insights into which of the other factors listed above might be most influential on bacterial behavior for the model.

7.1.2 Regulatory Criteria

A properly designed and applied model provides the source-response linkage component of the TMDL and enables accurate assessment of assimilative capacity and allocation distribution. A stream's assimilative capacity is determined through adherence to water quality objectives. The Regional Board's Basin Plan establishes, for all waters in the San Diego Region, the beneficial uses for each waterbody to be protected, the WQOs that protect those uses, and an implementation plan that accomplishes those objectives (see Section 2).
The modeling platform must enable direct comparison of model results to in-stream concentrations and allow for the analysis of the duration of those concentrations. For the watershed loading analysis and implementation of required reductions, it is also important that the modeling platform enable examination of gross land use loading as well as in-stream concentration.

7.2 Wet-Weather Modeling Analysis

During wet-weather conditions, sources of bacteria are usually associated with wash-off of bacteria accumulated on the land surface. During rainy periods, the bacteria are delivered to the waterbody through creeks and stormwater collection systems. Often, bacteria sources can be linked to specific land use types that have higher relative bacteria accumulation rates or are more likely to deliver bacteria to waterbodies because of delivery through stormwater collection systems. To assess the link between sources of bacteria and the impaired waters, a modeling system that simulates the build-up and wash-off of bacteria and the hydrologic and hydraulic processes that affect delivery is often used. Understanding and modeling of these processes provides the necessary decision support for TMDL development and allocation of loads to sources. This approach assumes the following:

- All sources can be represented through build-up/wash-off of bacteria from specific land use types.
- The discharge of sewage is zero. Sewage spill information was reserved for use during the calibration process to account for observed spikes in bacteria, as applicable; however, the calibration process did not necessitate removal of any wet-weather data considered to be affected by sewage spill information..
- For numeric target assessment at beaches, the critical points were assumed to be the point where the creek/watershed or storm drain initially mixes with ocean water at the surf zone.

The wet-weather approach is based on the application of USEPA's Loading Simulation Program in C++ (LSPC) to estimate bacteria loading from streams and assimilation within the waterbody. LSPC is a recoded C++ version of USEPA's Hydrological Simulation Program–FORTRAN (HSPF) that relies on fundamental (and USEPA-approved) algorithms. LSPC has been successfully applied and calibrated in the Los Angeles, San Gabriel, and San Jacinto Rivers in Southern California. For a complete discussion of LSPC configuration, calibration, and application, refer to Appendix C.

7.3 Dry-Weather Modeling Analysis

The variable nature of the dry-weather sources of bacteria required an approach that relied on detailed analysis of available data to better identify and characterize sources. Data collected from dry-weather samples were used to develop empirical relationships that represent water quantity and water quality associated with dry-weather runoff from various land uses. For each monitoring station, a watershed was delineated and the land use was related to flow and bacteria concentrations. A statistical relationship was established between flow, bacteria concentrations, and areas of each land use. A complete discussion of the statistical analysis of data and development of the empirical framework for estimating watershed bacterial loads is provided in Appendix D.

To represent the linkage between source contributions and in-stream response, a steady-state mass balance model was developed to simulate transport of bacteria in the impaired streams and the streams flowing to impaired shorelines. This predictive model represents the streams as a series of plug-flow reactors, with each reactor having a constant, steady-state flow and bacteria load. A complete description of configuration and calibration of the stream modeling network is provided in Appendix D.

The model was created to estimate bacteria concentrations in the San Diego Region, to develop necessary load allocations for TMDL development, and to allow for readily incorporating any new data. Bacteria concentrations in each segment were calculated using water quality data, a first-order die-off rate, stream infiltration, basic channel geometry, and flow.

8 Identification of Load Allocations and Reductions

The calibrated models were used to simulate flow and indicator bacteria densities for use in estimating existing bacteria loads to the impaired waterbodies. Existing loads were compared to numeric targets and associated TMDLs for identification of necessary load reductions. Methodologies for load assessments for determining load reductions to wet and dry urban runoff are described in the following sections.

8.1 Wet Weather Loading Analysis

The calibrated LSPC model (see Appendix C) was used to estimate existing bacteria loads at critical conditions for comparison to numeric targets and determination of required load reductions for each watershed identified as a source of bacteria to the impaired waterbodies (see Figures 1-1 and 1-2 and Table 1-1). The optimal reduction scenario resulted in reduced bacteria loads from controllable land uses. (Sources from urban runoff associated with MS4 permits were deemed controllable, whereas natural sources from open space were not).

8.1.1 Identification of the Critical Wet-Weather Condition

To ensure protection of the impaired waterbodies during wet periods, a critical period associated with extreme wet conditions was selected for loading analysis and TMDL calculations. This critical wet condition was selected based on identification of the 92^{nd} percentile of annual rainfalls observed over the past 12 years (1990 through 2002) at multiple rainfall gages in the San Diego Region (wettest year of the past 12). This resulted in selection of 1993 as the critical wet year for assessment of wet weather loading conditions. This condition was consistent with studies performed by the Southern California Coastal Research Project (SCCWRP), where a 90^{th} percentile year was selected based on rainfall data for the Los Angeles Airport (LAX) from 1947 to 2000, also resulting in selection of 1993 as the critical year (LARWQCB, 2002).

8.1.2 Wet-Weather Load Estimation

Assessment of existing loading to the impaired waterbodies required estimating of daily loads based on model-predicted flows and bacteria densities. The dynamic model-simulated watershed processes, based on observed rainfall data as model input, provided temporally variable load estimates for the critical period. These load estimates were simulated based on calibrated, land use-specific processes associated with hydrology and build-up and wash-off of bacteria from the land surface. Transport processes of bacteria loads from the source to the impaired waterbodies were also simulated in the model with a first-order loss rate based on literature values (see Appendix C).

For assessment of wet-weather loads, daily loads predicted for the critical wet year were selected based on wet conditions identified from local rainfall data for each modeled watershed. The wet condition was defined to be consistent with the California Department of Environmental Health's General Advisory to avoid contact with ocean and bay water within 300 feet on either side of any storm drain, river, or lagoon outlet, and it is designated as 72 hours after 0.2 inch or more of rain. The total number of wet days for each watershed affecting impaired waterbodies is listed in Table 6-1. For larger watersheds that extend into the mountains, where more rainfall is observed (e.g., San Luis Rey River, San Dieguito River, San Diego River), more wet days were identified. Although the Miramar watershed is near the coast and does not extend into the mountains as do the larger watersheds, localized rainfall patterns for 1993 showed in a large number of wet days relative to neighboring watersheds.

Table 6-1. Wet Days of the Critical Period (1993) Identified for Watersheds Affecting Impaired Waterbodies

Watershed	Number of Wet Days in 1993
Laguna/San Joaquin	69
Aliso Creek	69
Dana Point	69
San Juan Creek	76
San Clemente	73
San Luis Rey River	90
San Marcos	49
San Dieguito River	98
Miramar	94
Scripps	57
San Diego River	86
Chollas Creek	65
Pine Valley Creek	37

Only the model-predicted flows and bacteria densities for wet days defined above were considered in assessing of existing loads and developing of TMDLs. A separate modeling approach was used for assessing of dry-weather loads (see Section 6.2).

8.1.3 Identification of Wet-Weather Numeric Targets

As mentioned in Section 2.3.3, a two-phased approach was used for calculating TMDLs based on interim numeric targets and WQOs. The interim targets for FC, TC, and ENT for all waterbodies (including beaches and creeks) are based on REC-1 WQOs, with allowable frequencies of exceedance of WQOs based on the reference conditions of the Arroyo Sequit watershed in the Los Angeles Region. This interim period provides an opportunity for data collection and identification of exceedance frequencies for the San Mateo watershed of the San Diego Region (or identification of another appropriate reference watershed).

The TMDL targets are based on WQOs defined by the REC-1 beneficial uses of creeks, as well as the REC-1 *and* SHELL beneficial uses of beaches. Therefore, TMDL targets for creeks are based on REC-1 WQOs for FC, TC, and TC; TMDL targets for beaches are based on REC-1 WQOs for FC and ENT and SHELL WQOs for TC. For both beaches and creeks, no allowable exceedance frequencies are included because of the lack of an appropriate reference watershed identified in the San Diego Region. An appropriate reference watershed must be identified to represent of local environmental and bacteria loading conditions in the San Diego Region, and also to provide the information necessary for calculating exceedance frequencies associated with the SHELL WQOs. (The Los Angeles reference condition was established based on REC-1 WQOs). Prior to implementation of the TMDL targets, the TMDL can be reopened and revised if appropriate reference conditions are identified for the beaches and creeks of the San Diego Region.

Numeric targets are based on the single sample WQOs defined in the Basin Plan. Because wet-weather runoff and flows containing bacteria concentrations have a quick time of travel, resulting in a short residence time of bacteria in the waterbodies, the single-sample WQOs were determined most appropriate. Summaries of the interim and TMDL numeric targets for beaches and creeks are provided in Tables 6-2 and 6-3. For information regarding the schedule of implementation of these targets, see Section 8.

Table 6-2. Interim and TMDL Wet-Weather Numeric Targets for Beaches

Indicator Bacteria	Interim Period		TMDL	
	Numeric Target[a] (MPN/100mL)	Allowable Exceedance Frequency[b]	Numeric Target[c] (MPN/100mL)	Allowable Exceedance Frequency[d]
Fecal coliforms	400	0.19	400	0
Total coliforms	10,000	0.19	230	0
Enteroccoci	104	0.19	104	0

[a] Targets based on REC-1 single sample WQOs.
[b] Exceedance frequency based on reference condition observed in the Los Angeles Region.
[c] Targets based on REC-1 single-sample WQOs for FC and ENT and SHELL single-sample WQOs for TC.
[d] No reference watershed identified for the San Diego Region; if a reference watershed is identified for the San Diego Region in the interim period, the TMDL can be revised.

Table 6-3. Interim and TMDL Wet-Weather Numeric Targets for Creeks

Indicator Bacteria	Interim Period		TMDL	
	Numeric Target[a] (MPN/100mL)	Allowable Exceedance Frequency[b]	Numeric Target[a] (MPN/100mL)	Allowable Exceedance Frequency[c]
Fecal coliforms	400	0.19	400	0
Total coliforms	10,000	0.19	10,000	0
Enteroccoci	61	0.19	61	0

[a] Targets based on REC-1 single sample WQOs.
[b] Exceedance frequency based on reference condition observed in the Los Angeles Region.
[c] No reference watershed identified for the San Diego Region; if a reference watershed is identified for the San Diego Region in the interim period, the TMDL can be revised.

For the interim period, the total number of days that numeric targets may be exceeded based on reference conditions, or allowable exceedance days, was calculated for each of the watersheds contributing to impairments of the waterbodies addressed in this document. Calculations were performed by multiplying the allowable exceedance frequency (0.19) by the number of wet days for the critical period (Table 6-1). The resulting number of allowable exceedance days for each watershed is listed in Table 6-4.

Table 6-4. Allowable Exceedance Days for Watersheds Affecting Impaired Waterbodies

Watershed	Number of Allowable Exceedance Days for Interim Period
Laguna/San Joaquin	13
Aliso Creek	13
Dana Point	13
San Juan Creek	14
San Clemente	14
San Luis Rey River	17
San Marcos	9
San Dieguito River	19
Miramar	18
Scripps	11
San Diego River	16
Chollas Creek	12
Pine Valley Creek	7

8.1.4 Critical Points for TMDL Calculation

For TMDL calculation, the water quality at a *critical point* or location in an impaired waterbody is often compared to TMDL targets for assessment of required reductions of pollutant loads to meet TMDLs. This critical point is considered to be a conservative location for assessment of water quality conditions, and is therefore selected based on high bacteria loads predicted at that location. Although this critical point for water quality assessment is utilized for TMDL analysis, compliance to WQOs must be assessed and maintained for all segments of a waterbody to ensure that impairments of beneficial uses are not observed.

For beaches, the critical points for meeting numeric targets are at the mouths of the watersheds that contribute to the impairment of the waterbodies. Therefore, surf zone mixing and dilution of discharges from creeks and storm drains to the beach were not considered. Because beneficial uses of the beach are to be maintained at all locations, including the discharge point of creeks, the conservative approach was to maintain compliance with numeric targets at those discharge points where bacterial densities are assumed to be greatest. For development of TMDLs for impaired creeks, critical points were also selected at the mouths or bottom of the impaired creek segments. This approach provides an implicit margin of safety to ensure protection of the beneficial uses of the beaches and creeks under critical conditions.

8.1.5 Calculation of TMDLs and Allocations of Bacteria Loads

For each modeled subwatershed discharging to an impaired waterbody (subwatersheds and proximity to impaired waterbodies shown Appendix C), wet weather loads were compared to calculated allowable waste loads through the use of load-duration curves. Load duration curves rank the modeled flows into percentiles so that associated bacteria loads can be compared to

WQOs and allowable exceedances. Load-duration curves and TMDL calculations for the watersheds for interim and TMDL targets are provided in Appendices G and H, respectively. On each load-duration curve, much of the lower range of flow has no loads associated due to model predicted flows or bacterial concentrations close to zero. Although days were selected as wet periods based on a criterion associated with rainfall (0.2 inches or more of rainfall and the following 72 hours), some of these days were actually dry in terms of streamflow. The separate dry weather approach provides an effective assessment of bacteria loads during dry periods.

TMDLs and allocations of bacteria loads were calculated using the following steps:

1. Determined the existing loads and ranked into percentiles of increasing flows (represented as bars in load-duration curves);
2. Calculated waste load allocations (WLAs) —flows multiplied by respective numeric targets (represented as line in load-duration curves);
3. Determined the allowable exceedance loads as the highest loads corresponding to the number of allowable exceedance days (shown in blue in load-duration curves);
4. Calculated non-allowable exceedance loads (loads exceeding targets minus allowable exceedance loads from Step 3); and
5. Calculated the required annual load reduction (non-allowable exceedance minus WLAs).

Wet weather WLAs, combined with annual dry weather WLAs (see Section 6.2), provided annual TMDLs for the watersheds addressed.

8.1.6 Margin of Safety

There are two ways to incorporate the MOS (USEPA, 1991): (1) implicitly incorporate the MOS using conservative model assumptions to develop allocations and (2) explicitly specify a portion of the total TMDL as the MOS and use the remainder for allocations. For the wet-weather bacteria TMDLs, an implicit MOS was provided. Throughout the TMDL development process, conservative assumptions were employed. For example, assuming that the location of the critical point for beach bacteria TMDLs is at the point of stormwater discharge provides an MOS by ensuring that targets are met at increasing distances from the discharge, where dilution in the surf zone occurs.

8.1.7 Seasonality

Through simulation of an entire critical wet year, daily wet-weather loads were estimated for all seasons of that year and compared to TMDLs to determine necessary load reductions. Model simulation of a full year accounted for seasonal variations in rainfall, evaporation, and associated impacts on runoff and transport of bacteria loads to waterbodies. Although large storms in the wet season of the critical year were associated with large volumes of runoff that transported large bacteria loads, smaller storms of the dry season also provided large bacteria loads resulting from wash-off of bacteria that had accumulated on the surface during the preceding extended dry period. For extended dry periods, the separate dry-weather approach was used for estimating bacteria loads resulting from urban runoff.

8.2 Dry-Weather Loading Analysis

The calibrated, low-flow, steady-state model was used to estimate bacteria loads during dry weather conditions. The steady-state aspect of the model resulted in estimation of a constant load from each watershed assumed representative of the average flow and bacteria loading conditions resulting from various urban land use practices (e.g., runoff from lawn irrigation or sidewalk washing). A complete discussion of model development, calibration, and validation is provided in Appendix D.

8.2.1 Identification of the Critical Dry-Weather Condition

The critical dry period was based on predictions of steady-state flows based on results of analysis of average dry-weather flows observed in Aliso Creek, Rose Creek, and Tecolote Creek. Dry-weather days were selected based on the criterion that less than 0.2 inch of rainfall was observed on each of the previous 3 days. Based on analysis of dry-weather flow, critical flows were predicted for each impaired watershed (see Appendix D).

8.2.2 Dry Weather Load Estimation

For each watershed that affects impaired waterbodies addressed in this study, the dry weather model was used to estimate the flows and bacteria densities resulting from runoff and transport of dry-weather urban runoff. Estimation of source loadings was based on empirical relationships established between flow and bacteria densities and land use distribution in the watershed. Transport of bacteria loads was simulated using standard plug-flow equations to describe steady-state losses resulting from first-order die-off and stream infiltration (see Appendix D for more detail). Steady-state estimates of bacteria loads were assumed constant for all dry days.

For consistency with the wet-weather approach, dry days were assessed for the critical wet year, identified as 1993. This was an accounting measure used so that total combined TMDLs could be based on annual loads, but it did not after calculations of load reductions because those calculations were based on comparisons of predicted concentrations to numeric targets (see Section 6.2.3). The resulting dry days for each watershed are listed in Table 6-5.

Table 6-5. Dry Days of the Critical Period (1993) Identified for Watersheds Affecting Impaired Waterbodies

Watershed	Number of Dry Days in 1993
Laguna/San Joaquin	296
Aliso Creek	296
Dana Point	296
San Juan Creek	289
San Clemente	292
San Luis Rey River	275
San Marcos	316
San Dieguito River	267
Miramar	271
Scripps	308
San Diego River	279
Chollas Creek	300
Pine Valley Creek	328

8.2.3 Identification of Dry-Weather Numeric Targets

A two-phased approach was used for calculating TMDLs based on interim numeric targets and WQOs. For the interim period, TMDLs for FC, TC, and ENT were based on REC-1 WQOs. For TC, WQOs specific to the SHELL beneficial use are applicable at beaches. As a result, following expiration of the interim period, TMDL targets are based on REC-1 WQOs for FC and ENT, and SHELL WQOs for TC. The interim period allows sufficient time for data collection and special studies to verify the appropriateness of the SHELL beneficial use and associated WQOs for TC. Should these studies result in information that necessitates revisions of WQOs or the technical approach prior to implementation of TMDL targets, the TMDL can be reopened and revised.

Because of the steady-state characteristic of bacteria loads predicted through modeling analysis, the 30-day geometric mean WQOs were selected as appropriate numeric targets. Interim and TMDL numeric targets are presented in Table 6-6.

Table 6-6. Interim and TMDL Numeric Dry-Weather Targets for Beaches and Creeks

Indicator Bacteria	Interim Period (MPN/100 mL)		TMDL (MPN/100 mL)	
	Beaches[a]	Creeks[a]	Beaches[b]	Creeks[b]
Fecal coliforms	200	200	200	200
Total coliforms	1,000	1,000	70	1,000
Enteroccoci	35	33	35	33

[a] Targets consistent with WQOs; TC based on REC-1 beneficial use.

[b] Targets consistent with WQOs; TC based on SHELL beneficial use.

8.2.4 Critical Points for TMDL Calculation

Consistent with the approach used for wet weather analysis (Section 6.1.4), critical points for assessment of TMDL targets were selected at the mouths and bottom of creeks and watersheds that contribute to the impairment of beaches. This approach provides an implicit margin of safety to ensure protection of the beneficial uses of the beaches and creeks under critical conditions.

8.2.5 Calculation of TMDLs and Allocations of Bacteria Loads

For each modeled watershed discharging to an impaired waterbody (see Figures 1-1 and 1-2), calculation of bacteria WLAs and required load reductions were performed using the following steps:

1. Calculated the WLAs based on model-predicted flows multiplied by applicable numeric targets; and
2. Calculated required load reductions based on the difference between WLAs and model-predicted loads.

Results were combined with wet weather WLAs for determination of the total annual TMDLs.

8.2.6 Margin of Safety

An implicit MOS was incorporated through application of conservative assumptions throughout TMDL development. An important conservative assumption was the identification of the 30-day geometric mean WQOs as TMDL numeric targets. Compliance with the 30-day geometric mean WQOs provides assurance that TMDLs will result in the protection of beneficial uses by stressing the importance of maintaining sustained safe levels of bacteria densities over all dry periods. Another conservative assumption was the designation of the critical point for beach bacteria TMDLs as the point of stormwater discharge. Such conservativeness provides an MOS by ensuring that targets are met at increasing distances from the discharge, where dilution in the surf zone occurs.

8.2.7 Seasonality

The dry-weather approach addresses seasonality through assessment of average dry conditions and associated TMDLs during common dry periods not addressed through the wet-weather approach described in Section 6.1.

9 Total Maximum Daily Loads

A TMDL for a given pollutant and waterbody is comprised of the sum of individual waste load allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is represented by the equation:

$$TMDL = \sum WLAs + \sum LAs + MOS$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving waterbody while still achieving WQOs. In the case of beaches and creeks of the San Diego Region, applicable WQOs relate to the REC-1 and SHELL beneficial uses. In TMDL development, allowable loadings from pollutant sources that cumulatively amount to no more than the TMDL must be established; this provides the basis to establish water quality-based controls. TMDLs can be expressed on a mass loading basis (e.g., pounds of bacteria per year) or as a concentration in accordance with 40 CFR 130.2(l).

9.1.1 Waste load Allocations

Federal regulations (40 CFR 130.7) require TMDLs to include individual WLAs for each point source. The only point sources identified to affect impaired waterbodies addressed in this study were MS4s. USEPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from MS4s. The exiting loads estimated for TMDL calculations were solely the result of watershed runoff. Coverage of existing MS4 permits include portions of watersheds determined to impact the impaired waterbodies addressed in this study.

9.1.2 Load Allocations

Currently, no load allocations were assigned to nonpoint sources and natural background levels in the region. Until better information is available that describes the spatial coverage of MS4 permits, no distinction can be made regarding those areas of the watersheds included within MS4 coverages and areas currently not permitted for stormwater discharge. Once this information becomes available for the entire region, WLAs determined for MS4 permits can be redistributed to nonpoint source runoff and receive LAs. Such nonpoint source runoff includes background levels associated with runoff from natural areas not included within coverage of an MS4 permit. The interim implementation strategy provides sufficient time for collection of information that better distinguishes areas covered by MS4 permits so that TMDL allocations can potentially be reassigned from WLAs to LAs for nonpoint source runoff and background levels.

9.1.3 TMDLs and WLAs

TMDLs and associated WLAs are presented in Tables 7-1 through 7-6 for both interim and TMDL targets. TMDLs are presented for each impaired waterbody, with wet weather and dry weather WLAs reported separately.

Table 7-1. Interim TMDLs for Fecal Coliform

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Joaquin Hills HSA (901.11) & Laguna Beach HSA (901.12) Cameo Cove at Irvine Cove Dr. - Riviera Way at Heisler Park – North	101	309	5,179	57.2%	1,181	52,676	77.6%	154	5,041	96.9%	1,335
	103	872	47,497	80.4%							
Laguna Beach HSA (901.12) at Main Laguna Beach Laguna Beach at Ocean Avenue Laguna Beach at Laguna Ave. Laguna Beach at Cleo Street Arch Cove at Bluebird Canyon Rd. Laguna Beach at Dumond Drive	104	10,505	592,496	78.5%	15,611	652,339	75.5%	2,083	21,999	90.5%	17,694
	105	4,174	47,842	62.7%							
	106	932	12,001	68.5%							
Aliso HSA (901.13) Laguna Beach at Lagunita Place / Blue Lagoon Place at Aliso Beach Aliso Creek	201	630	19,386	86.2%	105,422	1,752,095	72.4%	2,383	53,972	95.6%	107,805
	202	104,792	1,732,709	72.2%							
Dana Point HSA (901.14) Aliso Beach at West Street Aliso Beach at Table Rock Drive 1000 Steps Beach at Pacific Coast Hwy at Hospital (9th Ave) at Salt Creek (large outlet) Salt Creek Beach at Salt Creek service road Salt Creek Beach at Dana Strand Road	301	507	12,677	81.9%	22,317	403,911	70.5%	912	18,263	95.0%	23,229
	302	715	13,426	75.8%							
	304	19,885	356,926	68.9%							
	305	367	10,149	83.5%							
	306	843	10,733	68.5%							
Lower San Juan HSA (901.27) San Juan Creek	401	381,639	15,304,790	75.2%	381,639	15,304,790	75.2%	16,038	62,179	74.2%	397,677

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Clemente HA (901.30) at Poche Beach (large outlet) Ole Hanson Beach Club Beach at Pico Drain	501	13,761	503,463	75.7%	39,339	1,441,719	71.9%	1,865	32,382	94.2%	41,204
San Clemente City Beach at El Portal St. Stairs San Clemente City Beach at Mariposa St.	502	3,342	81,333	62.2%							
San Clemente City Beach at Linda Lane San Clemente City Beach at South Linda Lane	503	13,867	736,628	72.3%							
San Clemente City Beach at Lifeguard Headquarters Under San Clemente Municipal Pier	504	4,235	81,576	67.9%							
San Clemente City Beach at Trafalgar Canyon (Trafalgar Ln.) San Clemente State Beach at Riviera Beach	505	2,875	22,705	48.0%							
San Clemente State Beach at Cypress Shores	506	1,259	16,014	47.7%							
San Luis Rey HU (903.00) at San Luis Rey River Mouth	701	662,782	33,120,012	61.9%	662,782	33,120,012	61.9%	9,697	15,918	39.1%	672,479
San Marcos HA (904.50) at Moonlight State Beach	1101	1,845	20,886	75.7%	1,845	20,886	75.7%	273	1,571	82.6%	2,118
San Dieguito HU (905.00) at San Dieguito Lagoon Mouth	1301	418	3,081	27.9%	467,838	21,286,909	39.6%	11,512	14,517	20.7%	479,350
	1302	467,420	21,283,828	39.6%							
Miramar Reservoir HA (906.10) Torrey Pines State Beach at Del Mar (Anderson Canyon)	1401	335	10,392	58.4%	335	10,392	58.4%	66	1,849	96.4%	401

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
Scripps HA (906.30) La Jolla Shores Beach at El Paseo Grande La Jolla Shores Beach at Caminito Del Oro La Jolla Shores Beach at Vallecitos La Jolla Shores Beach at Ave de la Playa at Casa Beach, Children's Pool South Casa Beach at Coast Blvd. Whispering Sands Beach at Ravina St. Windansea Beach at Vista de la Playa Windansea Beach at Bonair St. Windansea Beach at Playa del Norte Windansea Beach at Palomar Ave. at Tourmaline Surf Park Pacific Beach at Grand Ave.	1501	2,487	28,044	69.5%	12,561	204,057	78.2%	1,221	34,085	96.4%	13,782
	1503	4,692	98,955	81.2%							
	1505	2,530	44,212	80.0%							
	1507	2,852	32,846	72.1%							
San Diego HU (907.11) at San Diego River Mouth (aka Dog Beach)	1801	312,219	4,932,380	53.8%	312,219	4,932,380	53.8%	14,003	45,831	69.4%	326,222
Santee HSA (907.12) Forrester Creek	1801	312,219	4,932,380	53.8%	312,219	4,932,380	53.8%	14,003	45,831	69.4%	326,222
San Diego HU (907.11) & Santee HSA (907.12) San Diego River, Lower	1801	312,219	4,932,380	53.8%	312,219	4,932,380	53.8%	14,003	45,831	69.4%	326,222
Chollas HSA (908.22) Chollas Creek	1901	67,232	603,863	66.0%	67,232	603,863	66.0%	3,982	50,680	92.1%	71,214

[a] Model subwatershed (see Appendix C) is the number used in LSPC to identify the subwatershed associated with the listed segment(s) within a hydrologic region. Load duration curves and detailed TMDL tables for each subwatershed are provided in Appendix G.

[b] Percent reduction is calculated by dividing the non-allowable exceedance load by the total load using the allowance criteria. These values are presented for each subwatershed in Appendix G.

Table 7-2. TMDLs for Fecal Coliforms

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Joaquin Hills HSA (901.11) & Laguna Beach HSA (901.12) Cameo Cove at Irvine Cove Dr. - Riviera Way at Heisler Park – North	101	309	5,179	95.1%	1,181	52,676	97.9%	154	5,041	96.9%	1,335
	103	872	47,497	98.2%							
Laguna Beach HSA (901.12) at Main Laguna Beach Laguna Beach at Ocean Avenue Laguna Beach at Laguna Ave. Laguna Beach at Cleo Street Arch Cove at Bluebird Canyon Rd. Laguna Beach at Dumond Drive	104	10,505	592,496	98.2%	15,611	652,339	97.7%	2,083	21,999	90.5%	17,694
	105	4,174	47,842	92.3%							
	106	932	12,001	93.2%							
Aliso HSA (901.13) Laguna Beach at Lagunita Place / Blue Lagoon Place at Aliso Beach Aliso Creek	201	630	19,386	97.1%	105,422	1,752,095	95.2%	2,383	53,972	95.6%	107,805
	202	104,792	1,732,709	95.2%							
Dana Point HSA (901.14) Aliso Beach at West Street Aliso Beach at Table Rock Drive 1000 Steps Beach at Pacific Coast Hwy at Hospital (9th Ave) at Salt Creek (large outlet) Salt Creek Beach at Salt Creek service road Salt Creek Beach at Dana Strand Road	301	507	12,677	96.5%	22,317	403,911	96.3%	912	18,263	95.0%	23,229
	302	715	13,426	95.4%							
	304	19,885	356,926	96.5%							
	305	367	10,149	96.5%							
	306	843	10,733	92.4%							
Lower San Juan HSA (901.27) San Juan Creek	401	381,639	15,304,790	97.7%	381,639	15,304,790	97.7%	16,038	62,179	74.2%	397,677

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year))
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Clemente HA (901.30) at Poche Beach (large outlet) Ole Hanson Beach Club Beach at Pico Drain San Clemente City Beach at El Portal St. Stairs San Clemente City Beach at Mariposa St. San Clemente City Beach at Linda Lane San Clemente City Beach at South Linda Lane San Clemente City Beach at Lifeguard Headquarters Under San Clemente Municipal Pier San Clemente City Beach at Trafalgar Canyon (Trafalgar Ln.) San Clemente State Beach at Riviera Beach San Clemente State Beach at Cypress Shores	501	13,761	503,463	97.3%	39,339	1,441,719	97.5%	1,865	32,382	94.2%	41,204
	502	3,342	81,333	97.1%							
	503	13,867	736,628	98.1%							
	504	4,235	81,576	94.9%							
	505	2,875	22,705	94.6%							
	506	1,259	16,014	92.3%							
San Luis Rey HU (903.00) at San Luis Rey River Mouth	701	662,782	33,120,012	98.1%	662,782	33,120,012	98.1%	9,697	15,918	39.1%	672,479
San Marcos HA (904.50) at Moonlight State Beach	1101	1,845	20,886	92.5%	1,845	20,886	92.5%	273	1,571	82.6%	2,118
San Dieguito HU (905.00) at San Dieguito Lagoon Mouth	1301	418	3,081	86.7%	467,838	21,286,909	98.0%	11,512	14,517	20.7%	479,350
	1302	467,420	21,283,828	98.0%							
Miramar Reservoir HA (906.10) Torrey Pines State Beach at Del Mar (Anderson Canyon)	1401	335	10,392	97.0%	335	10,392	97.0%	66	1,849	96.4%	401

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
Scripps HA (906.30) La Jolla Shores Beach at El Paseo Grande La Jolla Shores Beach at Caminito Del Oro La Jolla Shores Beach at Vallecitos La Jolla Shores Beach at Ave de la Playa at Casa Beach, Children's Pool South Casa Beach at Coast Blvd. Whispering Sands Beach at Ravina St. Windansea Beach at Vista de la Playa Windansea Beach at Bonair St. Windansea Beach at Playa del Norte Windansea Beach at Palomar Ave. at Tourmaline Surf Park Pacific Beach at Grand Ave.	1501	2,487	28,044	92.9%	12,561	204,057	94.9%	1,221	34,085	96.4%	13,782
	1503	4,692	98,955	95.3%							
	1505	2,530	44,212	95.4%							
	1507	2,852	32,846	95.0%							
San Diego HU (907.11) at San Diego River Mouth (aka Dog Beach)	1801	312,219	4,932,380	93.7%	312,219	4,932,380	93.7%	14,003	45,831	69.4%	326,222
Santee HSA (907.12) Forrester Creek	1801	312,219	4,932,380	93.7%	312,219	4,932,380	93.7%	14,003	45,831	69.4%	326,222
San Diego HU (907.11) & Santee HSA (907.12) San Diego River, Lower	1801	312,219	4,932,380	93.7%	312,219	4,932,380	93.7%	14,003	45,831	69.4%	326,222
Chollas HSA (908.22) Chollas Creek	1901	67,232	603,863	90.8%	67,232	603,863	90.8%	3,982	50,680	92.1%	71,214

[a] Model subwatershed (see Appendix C) is the number used in LSPC to identify the subwatershed associated with the listed segment(s) within a hydrologic region. Load duration curves and detailed TMDL tables for each subwatershed are provided in Appendix H.

[b] Percent reduction is calculated by dividing the non-allowable exceedance load by the total load using the allowance criteria. These values are presented for each subwatershed in Appendix H.

Table 7-3. Interim TMDLs for Total Coliforms

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Joaquin Hills HSA (901.11) & Laguna Beach HSA (901.12) Cameo Cove at Irvine Cove Dr. - Riviera Way at Heisler Park – North	101	7,716	67,350	54.3%	29,520	628,669	72.8%	770	25,369	97.0%	30,290
	103	21,804	561,319	75.7%							
Laguna Beach HSA (901.12) at Main Laguna Beach Laguna Beach at Ocean Avenue Laguna Beach at Laguna Ave. Laguna Beach at Cleo Street Arch Cove at Bluebird Canyon Rd. Laguna Beach at Dumond Drive	104	262,616	6,278,214	70.9%	390,266	7,593,233	69.9%	10,415	110,707	90.6%	400,681
	105	104,355	1,076,489	67.5%							
	106	23,295	238,530	66.8%							
Aliso HSA (901.13) Laguna Beach at Lagunita Place / Blue Lagoon Place at Aliso Beach Aliso Creek	201	15,761	364,715	84.1%	2,635,557	23,210,774	64.3%	11,915	262,841	95.9%	2,647,472
	202	2,619,796	22,846,059	64.0%							
Dana Point HSA (901.14) Aliso Beach at West Street Aliso Beach at Table Rock Drive 1000 Steps Beach at Pacific Coast Hwy at Hospital (9th Ave) at Salt Creek (large outlet) Salt Creek Beach at Salt Creek service road Salt Creek Beach at Dana Strand Road	301	12,680	224,286	79.4%	557,910	6,546,962	64.9%	4,558	91,908	95.0%	562,468
	302	17,868	261,979	75.5%							
	304	497,130	5,599,516	62.1%							
	305	9,164	209,193	80.7%							
	306	21,068	251,988	67.1%							
Lower San Juan HSA (901.27) San Juan Creek	401	9,540,977	130,258,863	58.3%	9,540,977	130,258,863	58.3%	80,190	297,153	73.0%	9,621,167

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Clemente HA (901.30) at Poche Beach (large outlet) Ole Hanson Beach Club Beach at Pico Drain San Clemente City Beach at El Portal St. Stairs San Clemente City Beach at Mariposa St. San Clemente City Beach at Linda Lane San Clemente City Beach at South Linda Lane San Clemente City Beach at Lifeguard Headquarters Under San Clemente Municipal Pier San Clemente City Beach at Trafalgar Canyon (Trafalgar Ln.) San Clemente State Beach at Riviera Beach San Clemente State Beach at Cypress Shores	501	344,015	5,276,541	64.6%	983,469	16,236,540	61.7%	9,326	162,961	94.3%	992,795
	502	83,546	1,216,982	51.2%							
	503	346,674	7,101,860	60.4%							
	504	105,876	1,903,632	66.3%							
	505	71,873	439,306	45.7%							
	506	31,485	298,219	46.7%							
San Luis Rey HU (903.00) at San Luis Rey River Mouth	701	16,569,557	231,598,677	38.9%	16,569,557	231,598,677	38.9%	48,483	78,370	38.1%	16,618,040
San Marcos HA (904.50) at Moonlight State Beach	1101	46,114	515,278	76.2%	46,114	515,278	76.2%	1,364	7,907	82.7%	47,478
San Dieguito HU (905.00) at San Dieguito Lagoon Mouth	1301	10,447	130,532	41.3%	11,695,958	163,541,132	31.6%	57,563	67,236	14.4%	11,753,521
	1302	11,685,511	163,410,600	31.6%							
Miramar Reservoir HA (906.10) Torrey Pines State Beach at Del Mar (Anderson Canyon)	1401	8,363	212,986	53.6%	8,363	212,986	53.6%	328	9,307	96.5%	8,691

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
Scripps HA (906.30) La Jolla Shores Beach at El Paseo Grande La Jolla Shores Beach at Caminito Del Oro La Jolla Shores Beach at Vallecitos La Jolla Shores Beach at Ave de la Playa at Casa Beach, Children's Pool South Casa Beach at Coast Blvd. Whispering Sands Beach at Ravina St. Windansea Beach at Vista de la Playa Windansea Beach at Bonair St. Windansea Beach at Playa del Norte Windansea Beach at Palomar Ave. at Tourmaline Surf Park Pacific Beach at Grand Ave.	1501	62,173	768,912	72.7%	314,011	5,029,518	78.1%	6,103	171,530	96.4%	320,114
	1503	117,295	2,485,458	81.4%							
	1505	63,238	958,988	77.6%							
	1507	71,305	816,160	71.7%							
San Diego HU (907.11) at San Diego River Mouth (aka Dog Beach)	1801	7,805,470	72,757,569	55.3%	7,805,470	72,757,569	55.3%	70,017	269,592	74.0%	7,875,487
Santee HSA (907.12) Forrester Creek	1801	7,805,470	72,757,569	55.3%	7,805,470	72,757,569	55.3%	70,017	269,592	74.0%	7,875,487
San Diego HU (907.11) & Santee HSA (907.12) San Diego River, Lower	1801	7,805,470	72,757,569	55.3%	7,805,470	72,757,569	55.3%	70,017	269,592	74.0%	7,875,487
Chollas HSA (908.22) Chollas Creek	1901	1,680,809	15,390,608	67.2%	1,680,809	15,390,608	67.2%	19,910	250,803	92.1%	1,700,719

[a] Model subwatershed (see Appendix C) is the number used in LSPC to identify the subwatershed associated with the listed segment(s) within a hydrologic region. Load duration curves and detailed TMDL tables for each subwatershed are provided in Appendix G.

[b] Percent reduction is calculated by dividing the non-allowable exceedance load by the total load using the allowance criteria. These values are presented for each subwatershed in Appendix G.

Table 7-4. TMDLs for Total Coliforms

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Joaquin Hills HSA (901.11) & Laguna Beach HSA (901.12) Cameo Cove at Irvine Cove Dr. - Riviera Way at Heisler Park – North	101	177	67,350	99.8%	678	628,669	99.9%	54	25,369	99.8%	732
	103	501	561,319	99.9%							
Laguna Beach HSA (901.12) at Main Laguna Beach Laguna Beach at Ocean Avenue Laguna Beach at Laguna Ave. Laguna Beach at Cleo Street Arch Cove at Bluebird Canyon Rd. Laguna Beach at Dumond Drive	104	6,040	6,278,214	99.9%	8,976	7,593,233	99.9%	729	110,707	99.3%	9,705
	105	2,400	1,076,489	99.8%							
	106	536	238,530	99.8%							
Aliso HSA (901.13) Laguna Beach at Lagunita Place / Blue Lagoon Place at Aliso Beach Aliso Creek	201	362	364,715	99.9%	60,617	23,210,774	99.8%	834	262,841	99.7%	61,451
	202	60,255	22,846,059	99.7%							
Dana Point HSA (901.14) Aliso Beach at West Street Aliso Beach at Table Rock Drive 1000 Steps Beach at Pacific Coast Hwy at Hospital (9th Ave) at Salt Creek (large outlet) Salt Creek Beach at Salt Creek service road Salt Creek Beach at Dana Strand Road	301	292	224,286	99.9%	12,833	6,546,962	99.9%	319	91,908	99.7%	13,152
	302	411	261,979	99.9%							
	304	11,434	5,599,516	99.9%							
	305	211	209,193	99.9%							
	306	485	251,988	99.8%							
Lower San Juan HSA (901.27)[c] San Juan Creek	401	9,540,977	130,258,863	93.1%	9,540,977	130,258,863	93.1%	80,190	297,153	73.0%	9,621,167

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Clemente HA (901.30) at Poche Beach (large outlet) Ole Hanson Beach Club Beach at Pico Drain San Clemente City Beach at El Portal St. Stairs San Clemente City Beach at Mariposa St. San Clemente City Beach at Linda Lane San Clemente City Beach at South Linda Lane San Clemente City Beach at Lifeguard Headquarters Under San Clemente Municipal Pier San Clemente City Beach at Trafalgar Canyon (Trafalgar Ln.) San Clemente State Beach at Riviera Beach San Clemente State Beach at Cypress Shores	501	7,912	5,276,541	99.9%	22,620	16,236,540	99.9%	653	162,960	99.6%	23,273
	502	1,922	1,216,982	99.9%							
	503	7,974	7,101,860	99.9%							
	504	2,435	1,903,632	99.9%							
	505	1,653	439,306	99.8%							
	506	724	298,219	99.8%							
San Luis Rey HU (903.00) at San Luis Rey River Mouth	701	381,100	231,598,677	99.8%	381,100	231,598,677	99.8%	3,394	78,370	95.7%	384,494
San Marcos HA (904.50) at Moonlight State Beach	1101	1,061	515,278	99.8%	1,061	515,278	99.8%	95	7,907	98.8%	1,156
San Dieguito HU (905.00) at San Dieguito Lagoon Mouth	1301	240	130,532	99.8%	269,007	163,541,132	99.7%	4,029	67,236	94.0%	273,036
	1302	268,767	163,410,600	99.7%							
Miramar Reservoir HA (906.10) Torrey Pines State Beach at Del Mar (Anderson Canyon)	1401	192	212,986	99.9%	192	212,986	99.9%	23	9,307	99.8%	215

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
Scripps HA (906.30) La Jolla Shores Beach at El Paseo Grande La Jolla Shores Beach at Caminito Del Oro La Jolla Shores Beach at Vallecitos La Jolla Shores Beach at Ave de la Playa at Casa Beach, Children's Pool South Casa Beach at Coast Blvd. Whispering Sands Beach at Ravina St. Windansea Beach at Vista de la Playa Windansea Beach at Bonair St. Windansea Beach at Playa del Norte Windansea Beach at Palomar Ave. at Tourmaline Surf Park Pacific Beach at Grand Ave.	1501	1,430	768,912	99.9%	7,222	5,029,518	99.9%	427	171,529	99.8%	7,649
	1503	2,698	2,485,458	99.9%							
	1505	1,454	958,988	99.9%							
	1507	1,640	816,160	99.9%							
San Diego HU (907.11) at San Diego River Mouth (aka Dog Beach)	1801	179,526	72,757,569	99.7%	179,526	72,757,569	99.7%	4,901	269,592	98.2%	184,427
Santee HSA (907.12)[c] Forrester Creek	1801	179,526	72,757,569	99.7%	179,526	72,757,569	99.7%	4,901	269,592	98.2%	184,427
San Diego HU (907.11) & Santee HSA (907.12)[c] San Diego River, Lower	1801	179,526	72,757,569	99.7%	179,526	72,757,569	99.7%	4,901	269,592	98.2%	184,427
Chollas HSA (908.22)[c] Chollas Creek	1901	1,680,809	15,390,608	91.0%	1,680,809	15,390,608	91.0%	19,910	250,803	92.1%	1,700,719

[a] Model subwatershed (see Appendix C) is the number used in LSPC to identify the subwatershed associated with the listed segment(s) within a hydrologic region. Load duration curves and detailed TMDL tables for each subwatershed are provided in Appendix H.

[b] Percent reduction is calculated by dividing the non-allowable exceedance load by the total load using the allowance criteria. These values are presented for each subwatershed in Appendix H.

[c] TMDL results are based on the numeric target for creeks.

Table 7-5. Interim TMDLs for Enterococci

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Joaquin Hills HSA (901.11) & Laguna Beach HSA (901.12) Cameo Cove at Irvine Cove Dr. - Riviera Way at Heisler Park – North	101	80	8,374	94.7%	307	61,351	95.4%	27	4,268	99.4%	334
	103	227	52,977	95.6%							
Laguna Beach HSA (901.12) at Main Laguna Beach Laguna Beach at Ocean Avenue Laguna Beach at Laguna Ave. Laguna Beach at Cleo Street Arch Cove at Bluebird Canyon Rd. Laguna Beach at Dumond Drive	104	2,731	650,651	95.1%	4,058	791,298	95.4%	365	18,624	98.0%	4,423
	105	1,085	117,393	96.0%							
	106	242	23,254	95.3%							
Aliso HSA (901.13) Laguna Beach at Lagunita Place / Blue Lagoon Place at Aliso Beach Aliso Creek	201	164	21,646	96.6%	16,145	2,230,206	96.2%	394	45,525	99.1%	16,539
	202	15,981	2,208,560	96.3%							
Dana Point HSA (901.14) Aliso Beach at West Street Aliso Beach at Table Rock Drive 1000 Steps Beach at Pacific Coast Hwy at Hospital (9th Ave) at Salt Creek (large outlet) Salt Creek Beach at Salt Creek service road Salt Creek Beach at Dana Strand Road	301	132	16,137	96.2%	5,802	501,525	93.0%	160	15,462	99.0%	5,962
	302	186	22,871	96.3%							
	304	5,170	428,285	92.0%							
	305	95	11,603	96.1%							
	306	219	22,629	95.3%							
Lower San Juan HSA (901.27) San Juan Creek	401	58,200	12,980,098	95.9%	58,200	12,980,098	95.9%	2,646	52,338	94.9%	60,846

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Clemente HA (901.30) at Poche Beach (large outlet) Ole Hanson Beach Club Beach at Pico Drain San Clemente City Beach at El Portal St. Stairs San Clemente City Beach at Mariposa St. San Clemente City Beach at Linda Lane San Clemente City Beach at South Linda Lane San Clemente City Beach at Lifeguard Headquarters Under San Clemente Municipal Pier San Clemente City Beach at Trafalgar Canyon (Trafalgar Ln.) San Clemente State Beach at Riviera Beach San Clemente State Beach at Cypress Shores	501	3,578	570,531	94.4%	10,227	1,663,093	93.6%	326	27,415	98.8%	10,553
	502	869	105,718	90.4%							
	503	3,605	806,852	94.1%							
	504	1,101	120,842	92.4%							
	505	747	33,570	85.9%							
	506	327	25,580	88.0%							
San Luis Rey HU (903.00) at San Luis Rey River Mouth	701	172,323	18,439,920	88.3%	172,323	18,439,920	88.3%	1,697	13,442	87.4%	174,020
San Marcos HA (904.50) at Moonlight State Beach	1101	480	40,558	96.2%	480	40,558	96.2%	48	1,330	96.4%	528
San Dieguito HU (905.00) at San Dieguito Lagoon Mouth	1301	109	14,763	88.9%	121,638	14,796,210	82.5%	2,015	12,175	83.4%	123,653
	1302	121,529	14,781,447	82.5%							

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
Miramar Reservoir HA (906.10) Torrey Pines State Beach at Del Mar (Anderson Canyon)	1401	87	11,564	86.1%	87	11,564	86.1%	11	1,566	99.3%	98
Scripps HA (906.30) La Jolla Shores Beach at El Paseo Grande La Jolla Shores Beach at Caminito Del Oro La Jolla Shores Beach at Vallecitos La Jolla Shores Beach at Ave de la Playa at Casa Beach, Children's Pool South Casa Beach at Coast Blvd. Whispering Sands Beach at Ravina St. Windansea Beach at Vista de la Playa Windansea Beach at Bonair St. Windansea Beach at Playa del Norte Windansea Beach at Palomar Ave. at Tourmaline Surf Park Pacific Beach at Grand Ave.	1501	647	74,057	96.2%	3,267	377,839	96.4%	214	28,856	99.3%	3,481
	1503	1,220	185,674	97.1%							
	1505	658	62,646	95.7%							
	1507	742	55,462	94.8%							
San Diego HU (907.11) at San Diego River Mouth (aka Dog Beach)	1801	47,613	7,255,759	95.2%	47,613	7,255,759	95.2%	2,311	38,190	93.9%	49,924
Santee HSA (907.12) Forrester Creek	1801	47,613	7,255,759	95.2%	47,613	7,255,759	95.2%	2,311	38,190	93.9%	49,924
San Diego HU (907.11) & Santee HSA (907.12) San Diego River, Lower	1801	47,613	7,255,759	95.2%	47,613	7,255,759	95.2%	2,311	38,190	93.9%	49,924
Chollas HSA (908.22) Chollas Creek	1901	10,253	1,371,972	96.9%	10,253	1,371,972	96.9%	657	42,826	98.5%	10,910
Tijuana HU (911.00) Pine Valley Creek, Upper	2001	179	14,860	95.6%	179	14,860	95.6%	431	25,344	98.3%	610

[a] Model subwatershed (see Appendix C) is the number used in LSPC to identify the subwatershed associated with the listed segment(s) within a hydrologic region. Load duration curves and detailed TMDL tables for each subwatershed are provided in Appendix G.

[b] Percent reduction is calculated by dividing the non-allowable exceedance load by the total load using the allowance criteria. These values are presented for each subwatershed in Appendix G.

Table 7-6. TMDLs for Enterococci

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Joaquin Hills HSA (901.11) & Laguna Beach HSA (901.12) Cameo Cove at Irvine Cove Dr. - Riviera Way at Heisler Park – North	101	80	8,374	99.2%	307	61,351	99.5%	27	4,268	99.4%	334
	103	227	52,977	99.6%							
Laguna Beach HSA (901.12) at Main Laguna Beach Laguna Beach at Ocean Avenue Laguna Beach at Laguna Ave. Laguna Beach at Cleo Street Arch Cove at Bluebird Canyon Rd. Laguna Beach at Dumond Drive	104	2,731	650,651	99.6%	4,058	791,298	99.5%	365	18,624	98.0%	4,423
	105	1,085	117,393	99.2%							
	106	242	23,254	99.1%							
Aliso HSA (901.13) Laguna Beach at Lagunita Place / Blue Lagoon Place at Aliso Beach Aliso Creek	201	164	21,646	99.3%	16,145	2,230,206	99.4%	394	45,525	99.1%	16,539
	202	15,981	2,208,560	99.4%							
Dana Point HSA (901.14) Aliso Beach at West Street Aliso Beach at Table Rock Drive 1000 Steps Beach at Pacific Coast Hwy at Hospital (9th Ave) at Salt Creek (large outlet) Salt Creek Beach at Salt Creek service road Salt Creek Beach at Dana Strand Road	301	132	16,137	99.3%	5,802	501,525	99.2%	160	15,462	99.0%	5,962
	302	186	22,871	99.3%							
	304	5,170	428,285	99.2%							
	305	95	11,603	99.2%							
	306	219	22,629	99.1%							
Lower San Juan HSA (901.27) San Juan Creek	401	58,200	12,980,098	99.6%	58,200	12,980,098	99.6%	2,646	52,338	94.9%	60,846

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
San Clemente HA (901.30) at Poche Beach (large outlet) Ole Hanson Beach Club Beach at Pico Drain San Clemente City Beach at El Portal St. Stairs San Clemente City Beach at Mariposa St. San Clemente City Beach at Linda Lane San Clemente City Beach at South Linda Lane San Clemente City Beach at Lifeguard Headquarters Under San Clemente Municipal Pier San Clemente City Beach at Trafalgar Canyon (Trafalgar Ln.) San Clemente State Beach at Riviera Beach San Clemente State Beach at Cypress Shores	501	3,578	570,531	99.4%	10,227	1,663,093	99.4%	326	27,415	98.8%	10,553
	502	869	105,718	99.4%							
	503	3,605	806,852	99.6%							
	504	1,101	120,842	99.1%							
	505	747	33,570	99.0%							
	506	327	25,580	98.8%							
San Luis Rey HU (903.00) at San Luis Rey River Mouth	701	172,323	18,439,920	99.1%	172,323	18,439,920	99.1%	1,697	13,442	87.4%	174,020
San Marcos HA (904.50) at Moonlight State Beach	1101	480	40,558	99.0%	480	40,558	99.0%	48	1,330	96.4%	528
San Dieguito HU (905.00) at San Dieguito Lagoon Mouth	1301	109	14,763	99.3%	121,638	14,796,210	99.1%	2,015	12,175	83.4%	123,653
	1302	121,529	14,781,447	99.1%							
Miramar Reservoir HA (906.10) Torrey Pines State Beach at Del Mar (Anderson Canyon)	1401	87	11,564	99.3%	87	11,564	99.3%	11	1,566	99.3%	98

Hydrologic Descriptor	Wet Weather TMDL Results							Dry Weather TMDL Results			TMDL (Billion MPN/year)
	Model Subwatershed[a]	Waste Load Allocation (Billion MPN/year)	Total Load for Existing Condition (Billion MPN/year)	Percent Reduction[b]	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	Basinwide Waste Load Allocation (Billion MPN/year)	Basinwide Existing Load (Billion MPN/year)	Basinwide Percent Reduction	
Scripps HA (906.30) La Jolla Shores Beach at El Paseo Grande La Jolla Shores Beach at Caminito Del Oro La Jolla Shores Beach at Vallecitos La Jolla Shores Beach at Ave de la Playa at Casa Beach, Children's Pool South Casa Beach at Coast Blvd. Whispering Sands Beach at Ravina St. Windansea Beach at Vista de la Playa Windansea Beach at Bonair St. Windansea Beach at Playa del Norte Windansea Beach at Palomar Ave. at Tourmaline Surf Park Pacific Beach at Grand Ave.	1501	647	74,057	99.3%	3,267	377,839	99.3%	214	28,856	99.3%	3,481
	1503	1,220	185,674	99.3%							
	1505	658	62,646	99.2%							
	1507	742	55,462	99.2%							
San Diego HU (907.11) at San Diego River Mouth (aka Dog Beach)	1801	47,613	7,255,759	99.3%	47,613	7,255,759	99.3%	2,311	38,190	93.9%	49,924
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[a] Model subwatershed (see Appendix C) is the number used in LSPC to identify the subwatershed associated with the listed segment(s) within a hydrologic region. Load duration curves and detailed TMDL tables for each subwatershed are provided in Appendix H.

[b] Percent reduction is calculated by dividing the non-allowable exceedance load by the total load using the allowance criteria. These values are presented for each subwatershed in Appendix H.

10 Implementation

The Regional Board will add text here on implementation.

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